FIITJEE FARIDABAD

MOCK PRACTICE PAPER FOR

JEE -Mains- 2020

MOCK PRACTICE PAPER-14

Time: 3 hours | ***Maximum marks: 360***

INSTRUCTIONS

Caution: Question Paper CODE as given above MUST be correctly marked in the answer OMR sheet before attempting the paper. Wrong CODE or no CODE will give wrong results.

A. General Instructions

1. Attempt ALL the questions. Answers have to be marked on the OMR sheets.

2. The Test Booklet consists of **90** questions. The maximum marks are **360.**

3. There are ***Three*** parts in the question paper. **Part 1: Mathematics, Part 2 : Physics** and **Part 3 is Chemistry**. Each question is allotted **4 (four)** marks for correct response.

4. *Candidates will be awarded marks as stated above in instruction No. 3 for correct response of each question.* –1 *mark 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.*

5. There is only one correct response for each question. Filling up more than one response in any question will be treated as wrong response and marks for wrong response will be deducted accordingly as per instruction 4 above.

6. In OMR, **1 = A, 2 = B, 3 = C, 4 = D.**

Name of the Candidate :______________________________________

Batch :________________ **Date of Examination :**____________________

Enrolment Number :______________________________________

PART-A

SECTION - I

Straight Objective Type

This section contains 24 questions. Each question has 4 choices (1), (2), (3) and (4) for its answer, out of which **ONLY ONE** is correct.

1. The area bounded by the curves $\sqrt{x}+\sqrt{y}=1$ and x + y = 1 is

(1) $\frac{1}{3}$ (2) $\frac{1}{6}$

(3) $\frac{1}{2}$ (4) $\frac{5}{6}$

2. If a, b, c, d $\in$ R then the equation $(x^2 + ax - 3b)(x^2 - cx + b)(x^2 - dx + 2b) = 0$ has

(1) 6 real roots (2) At least 2 real roots

(3) 4 real roots (4) 3 real roots

3. The value of $\int_0^{100\pi}\left([\cot^{-1}x]+[\tan^{-1}x]\right)dx$ is (where [.] denotes greatest integer function)

(1) 100π + 1cot1 (2) 100π + 2cot2

(3) 2cot2 (4) 100π – 2cot2

4. Let $f(x) = \int_{-2}^{x} e^{(1+t)^2}dt$ and $g(x) = f(h(x))$ where h(x) is defined for all x $\in$ R. If $g'(2) = e^4$ and $h'(2) = 1$ then absolute value of sum of all possible values of h(2) is

(1) 2

(2) 3

(3) 4

(4) 0

5. $\sum_{j=1}^{21} a_j = 693$, where $a_1, a_2, ..., a_{21}$ are in A.P., then $\sum_{i=0}^{10} a_{2i+1}$ is

(1) 330

(2) 363

(3) 1386

(4) 333

6. $\int \frac{\sin 2x}{\sin 5x \sin 3x} dx =$

(1) $\ell n\sin 3x - \ell n\sin 5x + c$

(2) $\frac{1}{3}\ell n\sin 3x + \frac{1}{5}\ell n\sin 5x + c$

(3) $\frac{1}{3}\ell n\sin 3x - \frac{1}{5}\ell n\sin 5x = c$

(4) $3\,\ell n\sin 3x - 5\,\ell n\sin 5x + c$

(SPACE FOR ROUGH WORK)

7. The general solution of differential equation $(x^6y^4 + x^2)dy = (1-x^5y^5-xy)dx$, is

(1) $\ln|x| = xy + \frac{x^4y^4}{4} + C$

(2) $\ln|y| = xy + \frac{x^4y^4}{4} + C$

(3) $\ln|x| = xy + \frac{x^5y^5}{5} + C$

(4) $\ln|y| = xy + \frac{x^5y^5}{5} + C$

8. A spherical acetone drop evaporates at a rate proportional to its surface area at that instant. The radius of this drop initially is 3mm and after one hour it is found to be 2 mm. If r(t) represents radius of the drop at time 't', Then

(1) $r(t) = 3 - t$

(2) $r(t) = t - 3$

(3) $r(t) = 3 + t^2 - 2t$

(4) $r(t) = 3 - t^3$

9. If $x_1, x_2, x_3, \ldots\ldots, x_{2008}$ are in HP and $\sum_{i=1}^{2007} x_i x_{i+1} = \lambda x_1 x_{2008}$, then λ is

(1) 2008

(2) 1998

(3) 1863

(4) 2007

10. $\lim_{h\to 0} \frac{1}{h}\left[\int_a^{x+h} \sin^4 t\,dt - \int_a^{x} \sin^4 t\,dt\right] =$

(1) $\sin^4 x$

(2) $4\sin^3 x \cos x$

(3) 0

(4) $\frac{\sin^5 x}{5}$

11. If α, β be the roots of $x^2 - x - 1 = 0$ and $A_n = \alpha^n + \beta^n$, then A.M. of A_{n-1} and A_n is

(1) $2A_{n+1}$

(2) $(1/2)A_{n+1}$

(3) $2A_{n-2}$

(4) $\frac{1}{2}(A_{n-2})$

12. Solution of the differential equation

$(2x - 10y^3)\frac{dy}{dx} + y = 0$ is

(1) $(x - 2y^3) \cdot y^2 = c$

(2) $\left(x - \frac{2y^3}{5}\right)y^2 = c$

(3) $(x + 2y^3) \cdot y^2 = c$

(4) $\left(x + \frac{2y^3}{5}\right)y^2 = c$

(SPACE FOR ROUGH WORK)

13. If 2^{nd}, 5^{th}, and 9^{th} terms of an A.P. are in G.P., then the sum of all possible ratios of the first term to the common difference of A.P.

(1) $\frac{9}{8}$

(2) 9

(3) 8

(4) 1

14. If α, β are the roots of the equation

$ax^2 + bx + c = 0$, then $\frac{\alpha}{a\beta + b} + \frac{\beta}{a\alpha + b} =$

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

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

15. Let S_1, S_2, ...S_n be squares such that for each $n \geq 1$, the length of a side of S_n equals the length of a diagonal of S_{n+1}. If the length of a side of S_1 is 10 cm, then for which of the following values of n is the area of S_n less than 1 sq. cm ?

(1) 7

(2) 8

(3) 6

(4) 5

16. The sum to n terms of the series

11 + 103 + 1005 + ... is

(1) $\frac{1}{9}(10n - 1) + n^2$ (2) $\frac{1}{9}(10^n - 1) + 2n$

(3) $\frac{10}{9}(10^n - 1) + n^2$ (4) $\frac{10}{9}(10^n - 1) + 2n$

17. The value of the integral $\int_{-\pi/2}^{\pi/2} \log\left(\frac{a - \sin\theta}{a + \sin\theta}\right) d\theta$,

$a > 1$ is -

(1) 0

(2) 1

(3) 2

(4) – 2

18. The set of values of p for which both the roots of the quadratic equation,

$4x^2 - 20px + (25p^2 + 15p - 66) = 0$ are less than 2 will be

(1) (4/5, 2)

(2) $(2, \infty)$

(3) $(-1, 4/5)$

(4) $(-\infty, -1)$

(SPACE FOR ROUGH WORK)

19. Find the area covered by the curve

$y = \max.\{2 - x, 2, 1 + x\}$ with x-axis from $x = -1$ to $x = 1$ is

(1) 1/2

(2) 5/2

(3) 7/2

(4) 9/2

20. The value of $\int_0^{\pi/2} x \cot x \, dx$ is

(1) $\pi \ell n2$

(2) $-\pi \ell n2$

(3) $(\pi \ell n2)/2$

(4) $2\pi \ell n2$

21. The degree and order of differential equation of family of all parabolas whose axis is x-axis are respectively

(1) 1,2

(2) 2,1

(3) 1, 1

(4) 2, 2

22. The area bounded by parabola $y^2 = x$, straight line $y = 4$ and y-axis is

(1) $\frac{16}{3}$

(2) $\frac{64}{3}$

(3) $7\sqrt{2}$

(4) $\frac{32}{3}$

23. The ratio in which the area bounded by the curves $y^2 = 12x$ and $x^2 = 12y$ is divided by the line $x = 3$ is

(1) 15 : 49

(2) 13 : 480

(3) 13 : 37

(4) 1 : 1

24. The value of $\int_0^{\infty} f(x^n + x^{-n}) \log x \, \frac{dx}{x}$ is

(1) ∞

(2) 1

(3) –1

(4) 0

(SPACE FOR ROUGH WORK)

SECTION - II

Comprehension Type

This section contains 3 paragraphs. Based open each paragraph, there are 2 questions. Each question has 4 choices (1), (2), (3) and (4), out of which **ONLY ONE** is correct.

Paragraph for Question Nos. 25 to 26

If $S = \lim_{n\to\infty} \frac{1}{n} \sum_{r=0}^{kn} f\left(\frac{r}{n}\right)$, (for $k \in N$), then

$S = \int_0^k f(x)\,dx$. In this process $\frac{r}{n}$ transforms to x, Σ transforms to $\int$ and $\frac{1}{n}$ transforms to dx.

25. $\lim_{n\to\infty} \frac{1}{n} \left(\sin^2\frac{\pi}{2n} + \sin^2\frac{2\pi}{2n} + ... + \sin^2\frac{n\pi}{2n}\right)$ is equal to

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

(3) $\frac{1}{2}$ (4) 1

26. $\lim_{n\to\infty} \frac{1}{n^4} \left((n^2+1^2)(n^2+2^2)(n^2+3^2).......(n^2+4n^2)\right)^{1/n}$ is equal to

(1) $2\,\ell n\,5 + 2(\tan^{-1}2) - 4$ (2) $\frac{25e^{2\tan^{-1}2}}{e^4}$

(3) $\frac{\pi}{2} + (\ell n\,2) - 2$ (4) $\frac{2e^{\pi/2}}{e^2}$

Paragraph for Question Nos. 27 to 28

A differential equation of the form

$\frac{dy}{dx} = \frac{f(x,y)}{g(x,y)}$ where f and g are homogeneous function of x and y, and of the same degree, is called homogeneous differential equaiton and can be solved easily by putting y = vx.

27. The solution of the differential equation

$\frac{dy}{dx} = \frac{x^2+xy+y^2}{x^2}$ is

(1) $\tan^{-1}\left(\frac{x}{y}\right) = \ell ny + c$

(2) $\tan^{-1}\left(\frac{y}{x}\right) = \ell ny + c$

(3) $\tan^{-1}\left(\frac{y}{x}\right) = \ell nx + c$

(4) $\sin^{-1}\left(\frac{y}{x}\right) = \ell nx + c$

28. The solution of the differential equation,

$\frac{dy}{dx} + \frac{x(x^2+3y^2)}{y(y^2+3x^2)} = 0$ is

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

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

(3) $x^4 + y^4 + 6x^2y^2 = c$

(4) $x^4 + y^4 + 9x^2y^2 = c$

(SPACE FOR ROUGH WORK)

Paragraph for Question Nos. 29 to 30

We are giving the concept of arithmetic mean of m^{th} power. Let a, b > 0 and $a \neq b$ and let m be a real number. Then

$$\frac{a^m + b^m}{2} > \left(\frac{a+b}{2}\right)^m, \text{ if } m \in R \sim [0, 1]$$

However if $m \in (0, 1)$, then

$$\frac{a^m + b^m}{2} < \left(\frac{a+b}{2}\right)^m$$

Obviously if $m \in \{0, 1\}$, then

$$\frac{a^m + b^m}{2} = \left(\frac{a+b}{2}\right)^m$$

If a = b then equality comes in all cases.

On the basis of above information, answer the following questions :

29. If a, b be positive and a + b = 1 ($a \neq b$) and If $A = \sqrt[3]{a} + \sqrt[3]{b}$ then the correct statement is

(1) $A > 2^{2/3}$

(2) $A = \frac{2^{2/3}}{3}$

(3) $A < 2^{2/3}$

(4) $A = 2^{2/3}$

30. If x, y be positive real numbers such that $x^2 + y^2 = 8$, then the maximum value of x + y is

(1) 2

(2) 4

(3) 6

(4) 8

(SPACE FOR ROUGH WORK)

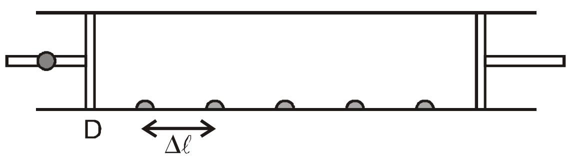
PART-B

SECTION - I

Straight Objective Type

This section contains 24 multiple choice questions. Each question has choices (1), (2), (3) and (4) out of which **ONLY ONE** is correct.

1. In a Kundt's tube distance between two consecutive heap is $\Delta\ell$ for air, while it is increased by 50% for a gas in the same tube with same resonite if speed of sound in air is $\frac{1000}{3} m/s^{-1}$ then speed of sound in gas at same temperature :



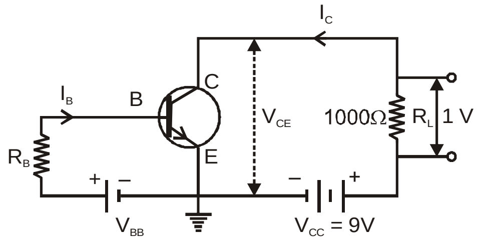
(1) 1500 m/s

(2) 500 m/s

(3) 1000 m/s

(4) To calculate speed in gas degree of freedom and molecular mass of the gas is required

2. An N-P-N transistor is connected in common emitter configuration in which collector supply is 9V and the voltage drop across the load resistance of 1000Ω connected in the collector circuit is 1 V. If current amplification factor is (25/26), If the internal resistance of the transistor is 200Ω, then which of the following options is **incorrect** :



(1) $V_{CE} = 8$ V

(2) collector current is 1.0 mA

(3) voltage gain $\frac{50}{23}$, and power gain is 4.6

(4) emitter current is 2.04 mA

3. A piece of iron is heated in a flame. It first becomes dull red then becomes reddish yellow and finally turns to white hot. The correct explanation for the above observation is possible by using :

(1) Wein's displacement Law

(2) Kirchoff's Law

(3) Newton's Law of cooling

(4) Stefan's Law

(SPACE FOR ROUGH WORK)

4. In a common emitter (CE) amplifier having a voltage gain G, the transistor used has transconductance 0.03 mho and current gain 25. If the above transistor is replaced with another one with transconductance 0.02 mho and current gain 20, the voltage gain will be :

(1) 1.5 G (2) $\frac{1}{3}$ G

(3) $\frac{5}{4}$ G (4) $\frac{2}{3}$ G

5. If we study the vibration of a pipe open at both ends, then the following statement is **not** true:

(1) Fundamental frequency will be inversely proportional to the length of pipe

(2) All harmonics of the fundamental frequency will be generated

(3) Pressure change will be maximum at both ends

(4) Open end will be displacement antinode

6. If photon of energy E and an electron have same energy E (kinetic energy), and De-Broglie wavelength of an electron is λ_e and De-Broglie wavelength of photon is λ_P. Then correct relation between λ_e and λ_P is :

(1) $\lambda_P \propto \lambda_e$ (2) $\lambda_P \propto \sqrt{\lambda_e}$

(3) $\lambda_P \propto \frac{1}{\sqrt{\lambda_e}}$ (4) $\lambda_P \propto \lambda_e^2$

7. The half life of a radioactive isotope 'X' is 20 years. It decays into another stable element 'Y'. The two elements 'X' and 'Y' were found to be in the ratio 1 : 7 in a sample of a given rock. Then age of the rock is estimated to be :

(1) 60 years

(2) 80 years

(3) 100 years

(4) 40 years

8. During an adiabatic process, the pressure of a gas is found to be proportional to the cube of its temperature. The ratio of $\frac{C_p}{C_v}$ for the gas is :

(1) 2

(2) $\frac{5}{3}$

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

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

9. Vernier constant of the Vernier callipers is :

(1) least count of Vernier callipers

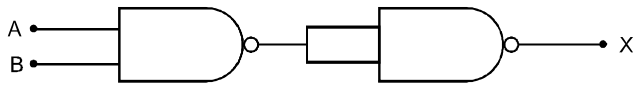
(2) value of 1 division of main scale

(3) value of 1 division of vernier scale

(4) None of these

(SPACE FOR ROUGH WORK)

10. The output(X) of the logic circuit shown in figure will be :



(1) $X = \overline{A \cdot B}$

(2) $X = A \cdot B$

(3) $X = \overline{A + B}$

(4) $2X = \overline{A \cdot B}$

11. A slab of stone of area 0.36 m^2 and thickness 0.1 m is exposed on the lower surface to steam at 100°C. A block of ice at 0°C rests on the upper surface of the slab. In one hour 4.8 kg of ice is melted. The thermal conductivity of slab is approximately : (Given latent heat of fusion of ice = 3.36×10^5 J kg^{-1})

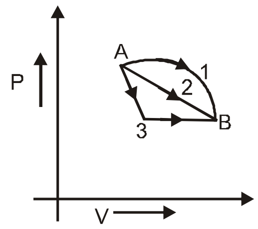
(1) 1.24 J/m/s/°C

(2) 1.29 J/m/s/°C

(3) 2.05 J/m/s/°C

(4) 1.02 J/m/s/°C

12. An ideal gas goes from state A to state B via three different processes as indicated in the P-V diagram :



If Q_1, Q_2, Q_3 indicate the heat a absorbed by the gas along the three processes and ΔU_1, ΔU_2, ΔU_3 indicate the change in internal energy along the three processes respectively , then

(1) $Q_1 > Q_2 > Q_3$ and $\Delta U_1 = \Delta U_2 = \Delta U_3$

(2) $Q_3 > Q_2 > Q_1$ and $\Delta U_1 = \Delta U_2 = \Delta U_3$

(3) $Q_1 = Q_2 = Q_3$ and $\Delta U_1 > \Delta U_2 > \Delta U_3$

(4) $Q_3 > Q_2 > Q_1$ and $\Delta U_1 > \Delta U_2 > \Delta U_3$

13. The equation of a simple harmonic wave is given by

$$y = 3\sin\frac{\pi}{2}(50t - x)$$

Where x and y are in meters and t is in seconds. The ratio of maximum particle velocity to the wave velocity is

(1) 2π

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

(3) 3π

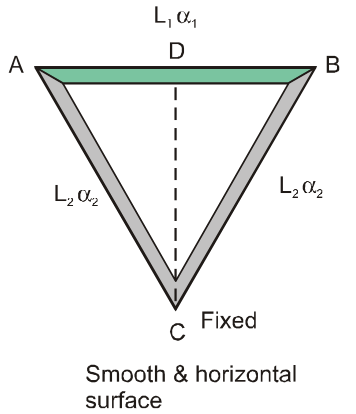
(4) $\frac{2}{3}\pi$

(SPACE FOR ROUGH WORK)

14. The input resistance of a silicon transistor is 100 Ω. Base current is changed by 40 μA which results in a change in collector current by 2mA. This transistor is used as a common emitter amplifier with a load resistance of 4 KΩ. The voltage gain of the amplifier is :

(1) 2000 (2) 3000
(3) 4000 (4) 1000

15. Figure shows isosceles triangle frame ABC of two different material shown in figure. Thermal expansion cofficient of the rod ADB is α_1 and for rod ACB is α_2. End C is fixed and whole system is placed on smooth horizontal surface and D is midpoint of rod AB and CD is perpendicular to the AB. If temperature of the system is increase such as it is found that distance CD remain fixed then.



(1) $\frac{\ell_1}{\ell_2} = 2\sqrt{\frac{\alpha_2}{\alpha_1}}$ (2) $\frac{\ell_1}{\ell_2} = 2\sqrt{\frac{\alpha_1}{\alpha_2}}$
(3) $\frac{\ell_1}{\ell_2} = \sqrt{\frac{\alpha_1}{\alpha_2}}$ (4) $\frac{\ell_1}{\ell_2} = \sqrt{\frac{\alpha_2}{\alpha_1}}$

16. The positron is the anti-matter counterpart of the electron. It has the same mass as an electron but the opposite charge. A photon is a particle of light. It has no charge, but has non-zero energy and momentum, proportional to the lights frequency. Away from all other matter an electron and positron moving towards each other with equal and opposite velocities.

(1) can annihilate into one photon, conserving both energy and momentum.
(2) can annihilate into one photon because energy and momentum are not conserved in quantum mechanics.
(3) cannot annihilate into one photon because energy cannot be conserved.
(4) cannot annihilate into one photon because momentum cannot be conserved.

17. If refractive index and dielectric constant of the material of a glass slab is $\frac{3}{2}$ and 3 respectively then magnetic permeability of the glass is (In SI system)

(1) 5.32×10^{-7} (2) 3.94×10^{-7}
(3) 10^{-7} (4) 9.42×10^{-7}

18. Choose the correct statements from the following

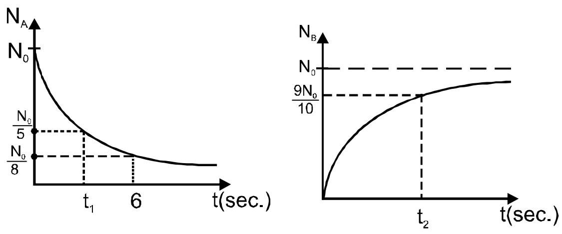
(1) Good reflectors are good emitters of thermal radiations
(2) Burns caused by water at 100ºC are more severe than those caused by steam at 100ºC.
(3) All bodies emit thermal radiations at all temperatures greater than 0 K.
(4) It is possible to construct a heat engine of 100% efficiency.

(SPACE FOR ROUGH WORK)

19. In a decay process A decays to B,

$$A \longrightarrow B$$

Two graphs of number of nucli of A and B versus time is given then, which of the following options is **incorrect** :



(1) $t_2 - t_1 = 4$

(2) $t_2 - t_1 = 2$

(3) $t_1 = 2 \log_2 5$

(4) $t_2 = \log_2 100$

20. Select correct statement regarding waves on a string [all symbols have their usual meanings] :

(1) Power transfer through any point in standing wave is $\mu v V_p^2$

(2) Energy is not conserve between consecutive node and antinode

(3) Two travelling waves of same frequency which are moving in opposite direction must form standing wave.

(4) Speed of particle in travelling wave is maximum where slope is maximum

21. A source emit sound waves of frequency 1000 Hz. The source moves to the right with a speed of 32 m/s relative to ground. On the right a reflecting surface moves towards left with a speed of 64 m/s relative to ground. The speed of sound in air is 332 m/s, then which of the following options is **incorrect** :

(1) wavelength of sound in ahead of source is 0.3 m

(2) number of waves arriving per second which meets the reflected surface is 1320

(3) speed of reflected wave is 268 m/s

(4) wavelength of reflected waves is nearly 0.2 m

22. $p = \frac{a - t^2}{bx}$:

p = pressure

x = distance

t = time

find the dimensions of $\frac{a}{b}$:

(1) $[M^2 L T^{-3}]$

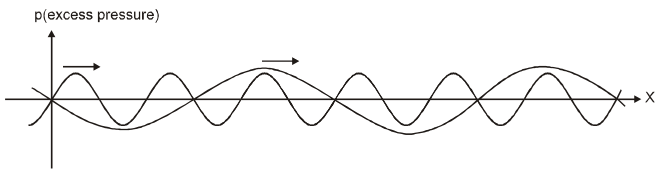
(2) $[M T^{-2}]$

(3) $[M L^3 T^{-1}]$

(4) $[L T^{-3}]$

(SPACE FOR ROUGH WORK)

23. Two longitudinal sinusoidal pressure waves one having lower frequency of 2Hz & both travelling in same direction through the same medium as shown in figure are superimposed. Then the difference in frequency of the two waves is -



(1) 1 Hz

(2) 2 Hz

(3) 3 Hz

(4) 4 Hz

24. Three samples of a radioactive substance have activity in a ratio 2:5:7 , then after two half lives the ratio of their activities will be :

(1) 2:5:7

(2) 1:3:5

(3) 7:5:2

(4) data insufficient

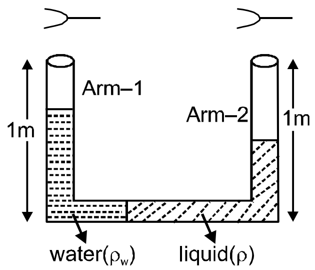
SECTION - II

Comprehension Type

This section contains 3 paragraphs. Based open each paragraph, there are 2 questions. Each question has 4 choices (1), (2), (3) and (4), out of which **ONLY ONE** is correct.

Paragraph for Question Nos. 25 to 26

A U–tube, open from both the ends, contains two arms, arm–1 and arm–2 each of having equal cross–section and height of each arm is 1m. Water of density ρ_w and an unknown liquid of density ρ is filled as shown.



A tuning fork of frequency 300 Hz is vibrated on arm–1, then a loud sound of fundamental tone is produced. If the same tuning fork is vibrated on arm–2, again a loud sound of 1st overtone is produced. (V_{sound} = 300 m/sec., g = 10 m/sec^2, density of water ρ_w = 10^3 kg/m^3, atmospheric pressure = 10^5 Pa). Neglect the effect of surface tension and end correction.

25. Density of the unknown liquid (ρ) is :

(1) $2\rho_w$ (2) $2.5\ \rho_w$

(3) $3\rho_w$ (4) $3.5\ \rho_w$

26. Now we use a tuning fork of frequency 302 Hz, instead of 300 Hz, with how much velocity should we move the tuning fork, so that resonance is created with the air column in any arm ?

(1) 2 m/sec. towards the tube

(2) 2 m/sec. away from the tube

(3) 4 m/sec. towards the tube

(4) 4 m/sec. away from the tube

(SPACE FOR ROUGH WORK)

Paragraph for Question Nos. 27 to 28

A message signal of 12 kHz and peak voltage 20 V is used to modulate a carrier wave of frequency 12 MHz and peak voltage 30 V. Then using the above information answer the following questions :

27. The modulation index in the given amplitude modulation is :

(1) 1/5 (2) 2/3

(3) 3/2 (4) 1

28. The lower side band (LSB) frequency of modulated wave is :

(1) 11 MHz to 12 MHz

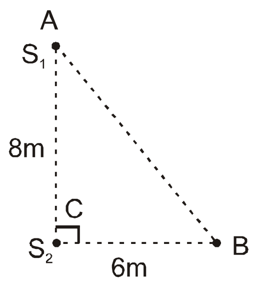
(2) 10 MHz to 12 MHz

(3) 12.012 MHz to 12 MHz

(4) 11.988 MHz to 12 kHz

Paragraph for Question Nos. 29 to 30

Two coherent point sound sources S_1 and S_2 are placed as shown in the figure. Both are emitting sound of frequency 165 Hz. S_1 is ahead of S_2 in phase by π-radian. (Speed of sound is 330 m/s)



29. How many times maximum sound can be observed on line AB :

(1) 7

(2) 6

(3) 5

(4) None of these

30. If power of sources are same and equal to 7200 π watt. Resultant intensity (in watt/m^2) at point B will be :

(1) $(\sqrt{50}-\sqrt{18})^2$

(2) $(\sqrt{30}-\sqrt{18})^2$

(3) $(\sqrt{50}+\sqrt{18})^2$

(4) None of these

(SPACE FOR ROUGH WORK)

PART- C

Atomic masses : [H = 1, D = 2, Li = 7, C = 12, N = 14, O = 16, F = 19, Na = 23, Mg = 24, Al = 27, Si = 28, P = 31, S = 32, Cl = 35.5, K = 39, Ca = 40, Cr = 52, Mn = 55, Fe = 56, Cu = 63.5, Zn = 65, As = 75, Br = 80, Ag = 108, I = 127, Ba = 137, Hg = 200, Pb = 207]

SECTION - I

Straight Objective Type

This section contains 30 questions. Each question has five choices (1), (2), (3), and (4) for its answer, out of which **ONLY ONE** is correct.

1. Which of the following MO has lowest energy for B_2 molecule ?

(1) $\sigma 2p_x$ (2) $\sigma^* 2p_x$

(3) $\pi 2p_y$ (4) $\pi^* 2p_y$

2. Unequal bond lengths are present in :

(1) BF_3

(2) CO_3^{2-} (present in $CaCO_3$)

(3) HNO_3

(4) SO_4^{2-}

3. In which of the following species, each atom carries same number of lone pair of electrons on it?

(1) XeO_4^{2-} (2) XeF_2

(3) XeO_6^{4-} (4) O_3

4. Which of the following has been named correctly ?

(1) $S_2O_3^{2-}$ thiosulphite ion

(2) N_3^- nitride ion

(3) $HAsO_3^{-2}$ monohydrogenarsenite ion

(4) $H_2PO_4^-$ dihydrogenphosphite ion

5. The oxide of an element which is stored under water and which exhibits allotropy is a powerful ....

(1) dehydrating agent

(2) reducing agent

(3) Fumigant

(4) Oxidizing agent

(SPACE FOR ROUGH WORK)

6. Which of the following statements is INCORRECT ?

(1) Complex $[Co(NH_3)_4(H_2O)Cl]Br_2$ can show both hydrate as well as ionization isomerism.

(2) Complex $[Co(NH_3)_5(H_2O)](NO_3)_3$ can show hydrate isomerism.

(3) Complex $[Pt(NH_3)_4][PtCl_6]$ cannot show coordination isomerism.

(4) $[Co(NH_3)_4(NO_2)Cl]Cl$ can show both ionization as well as linkage isomerism.

7. Usually a disilicate share only one oxygen of silicate unit. But if in the disilicate, two O atoms are shared, then formula of its salt with potassium is :

(1) $K_6Si_2O_7$ (2) $K_4Si_2O_6$

(3) $K_2Si_2O_6$ (4) $K_8Si_2O_8$

8. Bubbling CO_2 through which of the following will produce a white precipitate :

(1) $NaAlO_2$ (2) Na_2CO_3

(3) NaOH (4) $MgSO_4$

9. When conc. HNO_3 is treated with P_4O_{10} it forms

(1) N_2O (2) NO

(3) NO_2 (4) N_2O_5

10. Which is not correctly matched ?

(1) Basic strength of oxides

$Cs_2O < Rb_2O < K_2O < Na_2O < Li_2O$

(2) Stability of peroxides

$Na_2O_2 < K_2O_2 < Rb_2O_2 < Cs_2O_2$

(3) Stability of bicarbonates

$LiHCO_3 < NaHCO_3 < KHCO_3 < RbHCO_3 < CsHCO_3$

(4) Melting point

$NaF < NaCl < NaBr < NaI$

(1) 1 and 4 (2) 1 and 3

(3) 1 and 2 (4) 2 and 3

11. A substance X when heated with Y produces residue and odourless, gas which turns lime water milky. The silver nitrate is added to residue yellow precipitate is formed. X and Y could be

	X	Y		X	Y
(1)	MnO_2	S	(2)	$NaBrO_3$	C
(3)	KI	S	(4)	Na_2SO_4	C

12. An aqueous solution contains Al^{3+} & Zn^{2+} both. To this solution NH_4OH is added in excess.

(1) only $Al(OH)_3$ will be precipitated

(2) only $Zn(OH)_2$ will be precipitated

(3) both will be precipitated

(4) no precipitate will appear

(SPACE FOR ROUGH WORK)

13. (I) When copper ore is mixed with silica, in a reverberatory furnace copper matte is produced. The copper matte contains sulphides of copper (II) and iron (II).

(II) Zone refining is based on the principle that impurities are more soluble in molten metal than in solid metal.

(III) In the metallurgy of aluminium, graphite anode is oxidised to carbon monoxide and carbon dioxide.

Correct statements amongs the following are-

(1) I, II (2) II, III

(3) I, III (4) I, II

14. Among the following statements which is INCORRECT :

(1) In the preparation of compounds of Xe, Bartlett had taken O_2PtF_6 as a base compound because both O_2 and Xe have almost same ionisation enthalpy.

(2) Nitrogen does not show allotropy.

(3) A brown ring is formed in the ring test for NO_3^- ion. It is due to the formation of $[Fe(H_2O)_5(NO)]^{2+}$

(4)On heating with concentrated NaOH solution in an inert atmosphere of CO_2, red phosphorus gives PH_3 gas.

15. Which of the following statement is incorrect.

(1) Be dissolves in alkali forming $[Be(OH)_4]^{-2}$

(2) LiCl is soluble in pyridine.

(3) Alkaline earth metal Ion, because of their much larger charge to size ratio exert a much stronger electrostatic attraction on the oxygen of water molecule surrounding them.

(4) BeF_2 form complex ion with NaF in which Be goes with cation.

16. (I) V_2O_5, Cr_2O_3 are amphoteric oxides.

(II) Interstitial compounds are very reactive

(III) In its higher oxidation states, manganese forms stable compounds with oxygen and fluorine.

Correct statements amongs the following are-

(1) I, II (2) II, III

(3) I, III (4) I, II

17. $Na_2S_2O_3.5H_2O$ Sodium thiosulphate is used in photography to :

(1) remove reduced silver

(2) remove undecomposed AgBr as soluble silver thiosulphate complex

(3) convert the metallic silver to silver salt

(4) reduce the silver bromide grains to metallic silver

(SPACE FOR ROUGH WORK)

18. H_2S reacts with lead acetate forming a black compound which reacts with H_2O_2 to form another compound. The colour of the compound is :

(1) pink (2) black

(3) yellow (4) white

19. (I) $[MnCl_6]^{3-}$, $[FeF_6]^{3-}$ and $[CoF_6]^{3-}$ are paramagnetic having four , five and four unpaired electrons respectively.

(II) Valence bond theory gives a quantitative interpretation of the thermodynamic stabilities of coordination compounds.

(III) The crystal field splitting Δ_o , depends upon the field produced by the ligand and charge on the metal ion.

Amongs the following correct statements are :

(1) I, II (2) I, III

(3) I, II, III (4) II, III

20. When $[K]^+ [AgF_4]^-$ is reacted with BF_3 a red solid is formed. This red solid on reaction with Xe forms a brown solid and a fluoride of Xenon. This fluoride is

(1) XeF_2 (2) XeF_4

(3) XeF_6 (4) XeF_8

21. Which of the following ions does not have S–S linkage ?

(1) $S_2O_8^{2-}$ (2) $S_2O_6^{2-}$

(3) $S_2O_5^{2-}$ (4) $S_2O_3^{2-}$

22. Which of the following statement(s) is/are correct ?

(1) Chlorine dioxide (ClO_2) is powerful oxidising agent but bleaching action is lower than Cl_2

(2) ClO_2 in alkaline solution undergoes disproportionation.

(3) SF_4 has a square planar shape with S having two lone pair of electrons.

(4) Sulphur tetrafluoride hydrolysed by water to give SO_2 and HF

23.
$$Fe^{3+} + [Fe(CN)_6]^{3-} \longrightarrow X \xrightarrow{H_2O_2\ \text{Solution}} Z$$
$$X \xrightarrow{SnCl_2\ \text{Solution}} Y$$

Correct observation is

(1) X : White Y and Z are same (blue)

(2) X : Brown Y and Z are same (blue)

(3) X : Brown Y is blue, Z white

(4) X : White Y is brown, Z white

(SPACE FOR ROUGH WORK)

24. Which one is incorrect statement among the following ?

(1) PH_5 , SCl_6 and FCl_3 do not exist.

(2) $p\pi - d\pi$ bond is present in SO_2 molecule.

(3) 12 P–O bonds are present in P_4O_6 molecule.

(4) Bond angle in SiH_4 less than that in CH_4.

25. **(I)** [Co(EDTA)] $^-$ has two optical isomers.

(II) $[Co(NH_3)_4 (NO_2)_2]^+$ show linkage isomers.

(III) For [Pt (py)$(NH_3)(NO_2)$ Cl BrI], theoretically fifteen different geometrical isomers are possible.

(IV) [$Cr(H_2O)_4Cl_2$] Cl_2. $2H_2O$ can show hydrate as well as ionisation isomerism.

Amongs the following correct statements are :

(1) II, III (2) III

(3) I, III (4) I, II & III

26. Identify the least stable ion amongst the following :

(1) Ne^- (2) F^-

(3) B^- (4) C^-

27. When haematite ore is burnt in air with coke along with lime at 200°C, the process not only produces steel but also produces an important compound (A), which is useful in making building materials. The compound (A) is -

(1) SiO_2 (2) $CaSiO_3$

(3) FeO (4) Fe_2O_3

28. Which of the following is the **correct** order of ionisation energy :

(1) $Be^+ > Be$ (2) $Be > Be^+$

(3) C > Be (4) B > Be

(1) 2, 3 (2) 3, 4

(3) 1, 3 (4) None of these

29. In which of the following complex ion, the metal ion will have t_{2g}^6, e_g^0 configuration according to CFT:

(1) $[FeF_6]^{3-}$ (2) $[Fe(CN)_6]^{3-}$

(3) $[Fe(CN)_6]^{4-}$ (4) None of these

30. Ammonia, on reaction with hypochlorite anion can form :

(1) NO (2) NH_4Cl

(3) N_2H_4 (4) HNO_2

(SPACE FOR ROUGH WORK)

ANSWER KEY

MATHEMATICS		PHYSICS		CHEMISTRY	
1	1	1	2	1	3
2	2	2	3	2	3
3	2	3	1	3	2
4	1	4	4	4	3
5	2	5	3	5	1
6	3	6	4	6	3
7	3	7	1	7	2
8	1	8	3	8	1
9	4	9	1	9	4
10	1	10	2	10	1
11	2	11	1	11	2
12	1	12	1	12	1
13	3	13	2	13	2
14	2	14	1	14	4
15	2	15	1	15	4
16	3	16	4	16	3
17	1	17	4	17	2
18	4	18	3	18	4
19	4	19	1	19	2
20	3	20	4	20	1
21	1	21	3	21	1
22	2	22	2	22	2
23	1	23	4	23	2
24	4	24	1	24	4
25	3	25	3	25	4
26	2	26	2	26	1
27	3	27	2	27	2
28	3	28	4	28	3
29	3	29	2	29	3
30	2	30	1	30	3

HINTS & SOLUTIONS

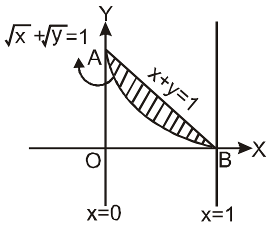
PART- A

MATHEMATICS

1. The area bounded by the..........................

Sol. (1)

The required area



$$= \text{area of } \Delta\,AOB - \int_0^1 \left(1-\sqrt{x}\right)^2 dx$$

$$= \frac{1}{2} - \left(x + \frac{x^2}{2} - 2\frac{x^{3/2}}{3/2}\right)_0^1 = \frac{1}{2} - \frac{1}{6} = \frac{1}{3}$$

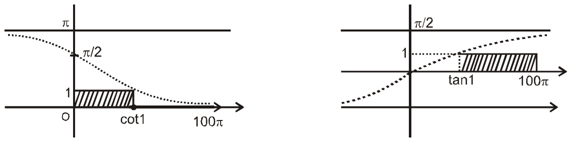
2. If a, b, c, d $\in$ R then ....

Sol. (2)

The discriminants of the given equation are, $D_1 = a^2 + 12b$;
$D_2 = c^2 - 4b$ and $D_3 = d^2 - 8b$
$\therefore D_1 + D_2 + D_3 = a^2 + c^2 + d^2 \ge 0$
$\Rightarrow$ At least one of D_1, D_2, D_3 is non-negative.
Hence, the equation has at least two real roots.

3. The value of $\int_0^{100\pi} \left([\cot^{-1} x] + [\tan^{-1} x]\right)$..............

Sol. (2)



$$\int_0^{100\pi} \left([\cot^{-1} x] + [\tan^{-1} x]\right) dx = \cot 1 + (100\pi - \tan 1)$$

$$= 100\pi + \frac{1-\tan^2 1}{\tan 1} = 100\pi + 2\cot 2$$

4. Let $f(x) = \int_{-2}^{x} e^{(1+t)^2} dt$ ....

Sol. (1) $g(x) = \int_{-2}^{h(x)} e^{(1+t)^2} dt \Rightarrow g'(x) = h'(x) \cdot e^{(1+h(x))^2}$

$\Rightarrow g'(2) = h'(2) \cdot e^{(1+h(2))^2}$

$\Rightarrow e^4 = 1 \cdot e^{(1+h(2))^2}$
$\Rightarrow 1 + h(2) = \pm 2$
$\Rightarrow h(2) = -3, 1$
$\Rightarrow$ sum $= -2 \Rightarrow |\text{sum}| = 2$

5. $\sum_{j=1}^{21} a_j = 693$, where ....

Sol. (2)

$\sum_{J=1}^{21} a_j = 693 = \frac{21}{2}(a_1 + a_{21})$, therefore $a_1 + a_{21} = 66$

Now, a_{11} = A.M. = 693/21 = 33
Also , $a_2 + a_{20} = a_3 + a_{19} = ... = a_9 + a_{13} = a_{10} + a_{12} = 66$

$\therefore \sum_{i=0}^{10} a_{2i+1} = 5 \times (a_1 + a_{21}) + a_{11} = 5 \times 66 + 33 = 363.$

6. $\int \frac{\sin 2x}{\sin 5x \sin 3x} dx$...............................

Sol. (3)

$$\int \frac{\sin 2x}{\sin 5x \sin 3x} dx = \int \frac{\sin(5x-3x)}{\sin 5x \sin 3x}$$

$$= \int \frac{\sin 5x \cos 3x - \cos 5x \sin 3x}{\sin 5x \sin 3x}$$

$$= \frac{1}{3} \ell n \sin 3x - \frac{1}{5} \ell n \sin 5x = c$$

7. The general solution.................................

Sol. (3) $(x^6y^4 + x^2)dy = (1 - x^5y^5 - xy)dx$
$x(xdy + ydx) - dx + x^5y^4 (xdy + ydx) = 0$

$$\Rightarrow \frac{dx}{x} = (1+x^4y^4)\, d(xy)$$

$$\Rightarrow \ln|x| = xy + \frac{x^5y^5}{5} + C$$

8. A spherical acetone ....

Sol. (1)

$$\frac{dv}{dt} = \lambda . 4\pi r^2 \qquad \Rightarrow 3\pi r^2 . \frac{dr}{dt} = \lambda . 4\pi r^2$$

$$\Rightarrow \frac{dr}{dt} = \lambda \quad = r = \lambda t + C$$

We have $r_0 = 3$ and $r = 2$ at $t = 1$
$\Rightarrow C = 3,\ 2 = \lambda + 3 \qquad \Rightarrow r = 3 - t$

9. If $x_1, x_2, x_3, \ldots, x_{2008}$ ....

Sol. (4)

Given $x_1, x_2, x_3, \ldots\ldots x_{2008}$ are in HP.

$\therefore \quad \frac{1}{x_1}, \frac{1}{x_2}, \frac{1}{x_3}, \ldots\ldots, \frac{1}{x_{2007}}, \frac{1}{x_{2008}}$ are in AP.

Then , $\frac{1}{x_2} - \frac{1}{x_1} = \frac{1}{x_3} - \frac{1}{x_2} = \ldots. = \frac{1}{x_{2008}} - \frac{1}{x_{2007}} = D$

or $\frac{x_1 - x_2}{x_1 x_2} = \frac{x_2 - x_3}{x_2 x_3} = \ldots. = \frac{x_{2007} - x_{2008}}{x_{2007} x_{2008}} = D$

$= \frac{(x_1 - x_2) + (x_2 - x_3) + \ldots + (x_{2007} - x_{2008})}{x_1 x_2 + \ldots. + x_2 x_3 + \ldots + x_{2007} x_{2008}} = D$

(by law of proportion)

or $x_1 x_2 + x_2 x_3 + \ldots. + x_{2007}\, x_{2008} = \frac{x_1 - x_{2008}}{D}$

or $\sum_{i=1}^{2007} x_i x_{i-1} = \frac{x_1 - x_{2008}}{D}$ ...(i)

Now , $\frac{1}{x_{2008}} = \frac{1}{x_1} + (2008 - 1)\, D$

or $\frac{x_1 - x_{2008}}{D} = 2007\, x_1\, x_{2008}$ ...(ii)

$\therefore$ From Eqs. (i) and (ii), we get

$\sum_{i=1}^{2007} x_i x_{i+1} = 2007\, x_1 x_{2008} \qquad \therefore \quad \lambda = 2007$

10. $\lim_{h \to 0} \frac{1}{h} \left[\int_a^{x+h} \sin^4 t\, dt - \int_a^{x} \sin^4 t\, dt \right]$ ....

Sol. (1)

Use L' Hospital rule, we get

$= \lim_{h \to 0} \frac{\sin^4 (x + h) - 0}{1} = \sin^4 x.$

11. If α, β be the roots of ....

Sol. (2)

$\alpha + \beta = 1$ and $\alpha\beta = -1$

AM of A_{n-1} and A_n = $\frac{A_{n-1} + A_n}{2}$

$= \frac{\alpha^{n-1} + \beta^{n-1} + \alpha^n + \beta^n}{2}$

$= \frac{\alpha^{n-1}(1 + \alpha) + \beta^{n-1}(1 + \beta)}{2}$

$= \frac{\alpha^{n-1}(\alpha^2) + \beta^{n-1}(\beta^2)}{2}$ ($\because$ $\alpha^2 = \alpha + 1$ and $\beta^2 - \beta + 1$)

$= \frac{1}{2} (\alpha^{n+1} + \beta^{n+1}) = \frac{1}{2} A_{n+1}.$

12. Solution of the differential ....

Sol. (1)

$(2x - 10y^3) \frac{dy}{dx} + y = 0$

$\Rightarrow \quad y \frac{dx}{dy} + 2x - 10y^3 = 0$

$\Rightarrow \quad \frac{dx}{dy} + \frac{2}{y} x - 10y^2 = 0$

I.F. $e^{\int \frac{2}{y} dy} = y^2$

$\Rightarrow \quad xy^2 = \int 10y^4 dy$

$\Rightarrow \quad xy^2 = 2y^5 + c$

$\Rightarrow \quad y^2 (x - 2y^3) = c$

13. If 2nd, 5th, and 9th terms ....

Sol. (3)

$a + d$, $a + 4d$, $a + 8d$ are in G.P.

$(a + 4d)^2 = (a + d)(a + 8d)$

$a^2 + 8ab + 16d^2 = a^2 + 9ad + 8d^2$

$\Rightarrow \quad 8d^2 = ad \qquad \Rightarrow \quad \frac{a}{d} = 8$

14. If α, β are the roots ....

Sol. (2)

$\alpha + \beta = -\frac{b}{a}$, $\alpha\beta = \frac{c}{a}$

$a\alpha + b = -a\beta$

$a\beta + b = -a\alpha$

$\therefore \quad \frac{\alpha}{a\beta + b} + \frac{\beta}{a\alpha + b} = -\frac{2}{a}$

15. Let S_1, S_2, ...S_n be.................................

Sol. (2)

We have length of a side of S_n = length of a diagonal of S_{n+1}

$\Rightarrow$ Length of a side of $S_n = \sqrt{2}$ (length of a side of S_{n+1})

$\Rightarrow \frac{\text{Length of a side of } S_{n+1}}{\text{Length of side of } S_n} = \frac{1}{\sqrt{2}}$ for all $n \geq 1$

$\Rightarrow$ Sides of S_1, S_2, ... S_n form a G.P. with common ratio $\frac{1}{\sqrt{2}}$ and first term 10.

$\therefore$ Side of $S_n = 10 \left(\frac{1}{\sqrt{2}} \right)^{n-1} = \frac{10}{2^{(n-1)/2}}$

$\Rightarrow$ Area of $S_n = (\text{side})^2$

$= \left(\frac{10}{2^{\frac{n-1}{2}}} \right)^2 = \frac{100}{2^{n-1}}$. Now, area of $S_n < 1 \Rightarrow n - 1 \geq 7$

16. The sum to n terms ....

Sol. (3)

Let S_n denote the sum to n terms of the given series. Then,

$Sn = 11 + 103 + 1005 + \ldots\ldots$ to n terms

$\Rightarrow S_n = (10 + 1) + (10^2 + 3) + (10^3 + 5) + \ldots\ldots. + \{10^n + (2n - 1)\}$

$\Rightarrow S_n = (10 + 10^2 + \ldots.. + 10^n) + \{1 + 3 + 5 + \ldots\ldots + (2n - 1)\}$

$\Rightarrow S_n = \frac{10(10^n - 1)}{(10 - 1)} + \frac{n}{2} (1 + 2n - 1) = \frac{10}{9} (10^n - 1) + n^2$

17. The value of the integral ....

Sol. (1)

$f(\theta) = \log \left(\frac{a - \sin\theta}{a + \sin\theta} \right)$ for which $f(-\theta) = \log \left(\frac{a + \sin\theta}{a - \sin\theta} \right)$

$$= -\log\left(\frac{a-\sin\theta}{a+\sin\theta}\right) = -f(\theta)$$

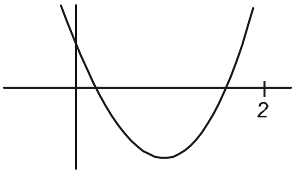
Hence, the integrand is an odd function. So, the given integral is zero.

18. The set of values of ....
Sol. (4)

$4x^2 - 20px + (25p^2 + 15p - 66) = 0$

$$x^2 - 5px + \frac{(25p^2 + 15p - 66)}{4} = 0$$

Case-I :



(i) $D \geq 0$

$$25p^2 - 4.1.\frac{(25p^2 + 15p - 66)}{4} \geq 0$$

$-15p + 66 \geq 0$
$15p - 66 \leq 0$

$$p \leq \frac{66}{15}$$

$$p \leq \frac{22}{5}$$

$$p \in \left(-\infty, \frac{22}{5}\right] \qquad ...(1)$$

(ii) $f(2) > 0$
$16 - 40p + 25p^2 + 15p - 66 > 0$
$25p^2 - 25p - 50 > 0$
$p^2 - p - 2 > 0$
$p^2 - 2p + p - 2 > 0$
$p(p-2) + 1(p-2) > 0$
$(p-2)(p+1) > 0$
$p \in (-\infty, -1) \cup (2, \infty) \qquad ...(2)$

(iii) $\frac{-b}{2a} < 2$

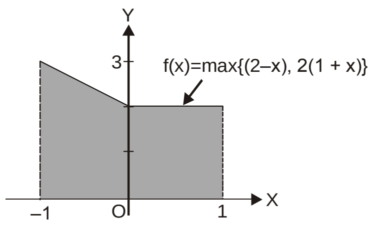
$$\frac{20p}{2.4} < 2 \Rightarrow p < \frac{16}{20} \Rightarrow p < \frac{4}{5}$$

$$p \in \left(-\infty, \frac{4}{5}\right) \qquad ...(3)$$

$(1) \cap (2) \cap (3)$
$p \in (-\infty, -1)$.

19. Find the area covered.................................
Sol. (4)

The graph of (x) = max {2 – x, 2, 1 + x} is shown as in the figure.



therefore, $\int_{-1}^{1} \max\{2-x, 2, 1+x\}\, dx$

= Area of the shaded region

$$= \frac{1}{2}(2+3) \times 1 + 1 \times 2 = \frac{9}{2}$$

20. The value of $\int_0^{\pi/2} x\cot x\, dx$............................
Sol. (3)

Integrating by parts taking cot x as second function, given integral

$$I = [x\log\sin x]_0^{\pi/2} - \int_0^{\pi/2}\log\sin x\, dx$$

$$= 0 - \lim_{x\to 0}(x\log\sin x) - \int_0^{\pi/2}\log\sin x\, dx = \frac{1}{2}\pi\log 2$$

$$\text{as } \lim_{x\to 0} x\log\sin x = \lim_{x\to 0}\left(\frac{\log\sin x}{1/x}\right)$$

$$= \lim_{x\to 0}\left(\frac{\cot x}{-1/x^2}\right) = \lim_{x\to 0}\left(\frac{-x^2}{\tan x}\right)$$

$$= \lim_{x\to 0}\left(-x, \frac{x}{\tan x}\right) = 0.1 = 0$$

21. The degree and order of ....
Sol. (1)

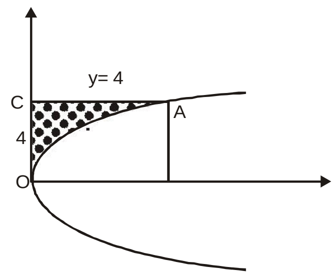
By repeated differentiation $y^2 = 4a(x + h)$
$yy_1 = 2a \Rightarrow yy_2 + y_1^2 = 0$
degree is 1 and order 2

22. The area bounded ....
Sol. (2)

y = 4 meets the parablola $y^2 = x$ at A is (16, 4)
Required area = Area of rectangle OMAC – Area OMA

$$= 4 \times 16 - \int_0^{16}\sqrt{x}\, dx = 64 - \left|\frac{x^{3/2}}{3/2}\right|_0^{16}$$

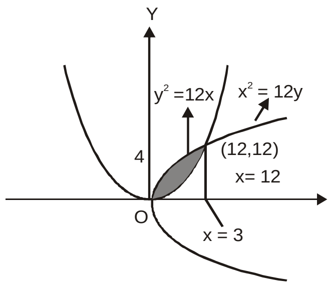
$$= 64 - \frac{2}{3}(4)^3 = 64 - \frac{128}{3} = \frac{64}{3} \text{ sq. units}$$



23. Thre ratio in which the ....
Sol. (1)

$$A_1 = \int_0^3 \sqrt{12x}\, dx - \int_0^3 \frac{x^2}{12}\, dx$$

$$= \sqrt{12}\left|\frac{2x^{3/2}}{3}\right|_0^3 - \frac{1}{36}\left|x^3\right|_0^3 = \frac{45}{4}$$



$$A_2 = \int_3^{12}\sqrt{12x}\,dx - \int_3^{12}\frac{x^2}{12}\,dx = \frac{147}{4} \text{ (on simplification)}$$

$\therefore$ Required ratio = 45 : 147, ie.e., 15 : 49

24. The value of $\int_0^{\infty} f(x^n + x^{-n})$ ....

Sol. (4)

Here limits and type of function suggest that there is something which is reciprocal to each other.

Let, $t = 1/x \Rightarrow x = 1/t \Rightarrow dx = -\frac{1}{t^2}\,dt$

Also when $x \to 0,\ t \to \infty;\ x \to \infty,\ t \to 0$

$$\Rightarrow I = \int_0^{\infty} f(x^n + x^{-n})\,\ell n\, x\,\frac{dx}{x}$$

$$= \int_{\infty}^{0} f(t^{-n} + t^{n})\,\ell n\left(\frac{1}{t}\right)\frac{-\frac{dt}{t^2}}{\frac{1}{t}}$$

$$= -\int_0^{\infty} f(t^n + t^{-n})\,\ell n(t)\,\frac{dt}{t} = -I \Rightarrow 2I = 0 \Rightarrow I = 0$$

25. $\lim\limits_{n\to\infty}\frac{1}{n}$ ....

Sol. (3)

$$\lim_{n\to\infty}\frac{1}{n}\left(\sin^2\frac{\pi}{2n} + \sin^2\frac{2\pi}{2n} + \ldots\ldots + \sin^2\frac{n\pi}{2n}\right)$$

$$= \int_0^1 \sin^2\left(\frac{\pi}{2}x\right)dx = \int_0^1 \cos^2\left(\frac{\pi}{2}x\right)dx$$

$\therefore\ 2I = 1 \qquad \therefore\ I = \frac{1}{2}$

26. $\lim\limits_{n\to\infty}\frac{1}{n^4}$ ....

Sol. (2)

$$\ell n\, S = \frac{1}{n}\sum_{r=0}^{2n}\ell n\,\frac{n^2 + r^2}{n^2} = \frac{1}{n}\sum_{r=0}^{2n}\ell n\left(1 + \left(\frac{r}{n}\right)^2\right)$$

$$= \int_0^2 \ell n\,(1 + x^2)\,dx = x\,\ell n\,(1 + x^2)\Big|_0^2 - \int_0^2 \frac{2x^2}{1 + x^2}\,dx$$

$$= 2\,\ell n\, 5 - 2\left(\int_0^2 1\,dx - \int_0^2 \frac{dx}{1 + x^2}\right) = 2\,\ell n\, 5 - 4 + 2\tan^{-1}2$$

$$\therefore\quad S = e^{2\ell n 5 - 4 + 2\tan^{-1}2} = \frac{25}{e^4}\,e^{2\tan^{-1}2}$$

27. The solution of the ....

Sol. (3)

Put y = vx

Differential equation becomes

$$v + x\frac{dv}{dx} = \frac{x^2 + x^2v + v^2x^2}{x^2} = 1 + v + v^2$$

$$\int\frac{dv}{1 + v^2} = \int\frac{dx}{x}$$

$$\tan^{-1}v = \ell nx + c \Rightarrow \tan^{-1}\left(\frac{y}{x}\right) = \ell nx + c$$

28. The solution of the ....

Sol. (3)

Put y = vx

Differential equation becomes

$$\int\frac{4(v^3 + 3v)}{v^4 + 6v^2 + 1}\,dv = -4\int\frac{dx}{x}$$

$$\ell n(v^4 + 6v^2 + 1) = -4\ell nx + \ell nc$$

$\Rightarrow\ x^4 + y^4 + 6x^2y^2 = c$

29. If a, b be positive ....

Sol. (3)

$$\frac{a^{1/3} + b^{1/3}}{2} < \left(\frac{a + b}{2}\right)^{1/3} = \left(\frac{1}{2}\right)^{1/3} \quad (\because\ a + b = 1)$$

$$\therefore\quad \frac{a^{1/3} + b^{1/3}}{2} < \frac{1}{2^{1/3}}$$

$\Rightarrow\ A < \frac{2}{2^{1/3}}$ or $A < 2^{2/3}$

30. If x, y be positive real ....

Sol. (2)

$$\because\ \frac{(x^2)^{1/2} + (y^2)^{1/2}}{2} < \left(\frac{x^2 + y^2}{2}\right)^{1/2} = \left(\frac{8}{2}\right)^{1/2} = 2$$

$$\Rightarrow \frac{|x| + |y|}{2} \le 2$$

or $|x| + |y| \le 4 \Rightarrow x + y \le 4$

PART- B

PHYSICS

31. In a Kundt's tube ....
Sol. **(2)**
$\lambda_{air} = 2\Delta\ell$
$\lambda_{gas} = 2\Delta\ell'$

$$\frac{V_{gas}}{V_{air}} = \frac{f\lambda_{gas}}{f\lambda_{air}} = \frac{\Delta\ell'}{\Delta\ell}$$

$$V_{gas} = \frac{1000}{3} \times \frac{3}{2}\ \frac{\Delta\ell}{\Delta\ell} = 500\ m/s^{-1}$$

32. An N-P-N ....
Sol. **(3)**
The circuit arrangement is shown in figure. Collector current, I_C

$$= \frac{\text{Voltage drop across } R_L}{R_L} = \frac{1}{1000} = 10^{-3}\text{amp}$$

Now $V_{CE} = 9 - 1 = 8$ volt

Current gain $\beta = \frac{I_C}{I_B}$

or $\frac{25}{26} = \frac{10^{-3}}{I_B}$

$\therefore \quad I_B = 1.04 \times 10^{-3}$ amp

Voltage gain $= \beta \frac{R_L}{R_C}$

$$= \frac{25}{26} \times \frac{1000}{200} = \frac{125}{26}$$

Power gain

$$= \beta^2 \frac{R_L}{R_C} = \left(\frac{25}{26}\right)^2 \times \frac{1000}{200} = \left(\frac{25}{26}\right)^2 \times 5 = 4.6$$

Again $I_E = I_B + I_C = 1.04 \times 10^{-3} + 10^{-3} = 2.04 \times 10^{-3}$A

33. A piece of ....
Sol. **(1)**
Wein's displacement law

$$\lambda_{max} \propto \frac{1}{T}$$

34. In a common ....
Sol. **(4)**

$$A_V = \beta \frac{R_{out}}{R_{in}} \Rightarrow G = 25\ \frac{R_{out}}{R_1} \qquad \text{.......(i)}$$

$$G_m = \frac{\beta}{R_1} \Rightarrow R_1 = \frac{\beta}{G_m} = \frac{25}{0.03}$$

$$G = 25\ \frac{R_{out}}{25} \times 0.03 \qquad \text{......(i)}$$

$$G' = 20\ \frac{R_{out}}{20} \times 0.02 \qquad \text{......(ii)}$$

$$G' = \frac{2}{3}\ G$$

35. If we study ....
Sol. **(3)**
Pressure change will be minimum at both ends

36. If photon of ....
Sol. **(4)**

$$P = \frac{E}{C} \qquad \text{...(i)}$$

$$\lambda_P = \frac{hC}{E} \qquad \text{...(ii)}$$

$$\lambda_e^2 = \frac{h}{2mE}$$

$$\frac{\lambda_p}{\lambda_e^2} = 2mC$$

$$\lambda_P \propto \lambda_e^2$$

37. The half life of ....
Sol. **(1)**

	X	$\rightarrow$	Y$_0$
at t = 0		N_0	0
at t = t		N	$N_0 - N$

$$\frac{N}{N_0 - N} = \frac{1}{7}$$

$$\frac{N}{N_0} = \frac{1}{8}$$

$t = 3t_{1/2}$
$t = 3 \times 20 = 60$ year

38. During an adiabatic ....
Sol. **(3)**
$P \propto T^3$
$P = KT^3$

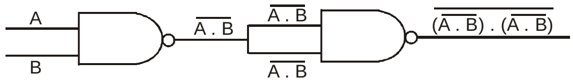
$$P = K\left(\frac{PV}{nR}\right)^3$$

P^2V^3 = constant
$PV^{3/2}$ = constant

$$\gamma = \frac{C_p}{C_v} = \frac{3}{2}$$

39. Vernier constant ....
Ans. **(1)**

40. The output(X) ....
Sol. **(2)**

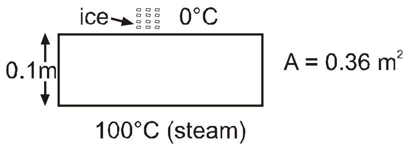


$$= \overline{\overline{A\,.\,B}} = AB$$

Alternate:

A	B	X
0	0	0
1	0	0
0	1	0
1	1	1

41. A slab of stone ....
Sol. **(1)**



Rate of heat given by steam = Rate of heat taken by ice

$$\frac{dQ}{dt} = \frac{KA(100-0)}{\ell} = m\frac{dL}{dt}$$

$$\frac{K \times 100 \times 0.36}{0.1} = \frac{4.8 \times 3.36 \times 10^5}{60 \times 60}$$

K = 1.24 J/m/s/°C

42. An ideal gas goes ....
Sol. **(1)**
Intial and final condition is same for all process
$\Delta U_1 = \Delta U_2 = \Delta U_3$
$\Delta Q = \Delta U + \Delta W$
Work done $\Delta w_1 > \Delta w_2 > \Delta w_2$ (Area of P.V. graph)
So $\Delta Q_1 > \Delta Q_2 > \Delta Q_3$

43. The equation of ....
Sol. **(2)**

$y = 3\sin\frac{\pi}{2}(50t - x)$

$y = 3\sin\left(25\pi t - \frac{\pi}{2}x\right)$

Wave velocity $v = \frac{\omega}{k} = \frac{25\pi}{\pi/2}$ = 50 m/sec.

$v_P = \frac{\partial y}{\partial t} = 75\pi\cos\left(25\pi t - \frac{\pi}{2}x\right)$

$v_{p\,max} = 75\pi$

then $\frac{v_{p_{max}}}{v} = \frac{75\pi}{50} = \frac{3\pi}{2}$

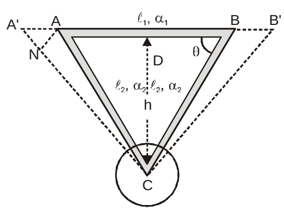
44. The input resistance ....
Sol. **(1)**

Voltage gain $= \frac{V_{out}}{V_{in}} = \frac{I_{out}}{I_{in}} \times \frac{R_{out}}{R_{in}}$

$= \frac{2 \times 10^{-3}}{40 \times 10^{-6}} \times \frac{4 \times 10^3}{100}$

= 2 × 1000 = 2000

45. Figure shows isosceles ....
Sol. **(1)**



According to condition of the problem, height of the isosceles triangle ABC is unchanged. The dotted lines show configuration after a temperature rise. Increase in length of rod AB,

$\Delta\ell_1 = \ell_1\alpha_1\Delta T$

Thus AA' = 1/2 $\ell_1\alpha_1\Delta T$

We draw a normal from A to A'C (the final length of AC). Increase in length of AC is A'N

A'N = $\ell_2\alpha_2\Delta T$

Considering increase in angle θ to be very small.

A'N $\simeq$ AA' cos θ

Where $\cos\theta = \frac{\ell_1}{2\ell_2}$

Thus, we have $\ell_2\alpha_2\Delta T = \left(\frac{1}{2}\ell_1\alpha_1\Delta T\right)\left(\frac{\ell_1}{2\ell_2}\right)$

Hence $\frac{\ell_1}{\ell_2} = 2\sqrt{\frac{\alpha_2}{\alpha_1}}$

46. The positron is ....
Sol. **(4)**
Cannot annihilate into a photon because momentum cannot be conserved.
The total momentum of the electron-positron pair is zero. Hence by momentum conservation, the momentum conservation, the momentum of a photon resulting from annihilate must also be zero. But this is impossible as the photon is stated to have non-zero momentum.

47. If refractive index ....
Sol. **(4)**

$\mu = \frac{3}{2} = \frac{C}{V}$

$V = \frac{2C}{3} = \frac{1}{\sqrt{\varepsilon_g \mu_g}}$; $2 \times 10^8 = \frac{1}{\sqrt{\varepsilon_g \cdot \mu_g}}$

$4 \times 10^{16} = \frac{1}{3\varepsilon_0 \cdot \mu_g}$; $\mu_g = \frac{1}{3(4\varepsilon_0) \times 10^{16}}$

$\mu_g = \frac{\pi}{3(4\pi\varepsilon_0) \times 10^{16}} = \frac{\pi}{3} \times \frac{9 \times 10^9}{10^{16}}$

$= 3\pi \times 10^{9-16}$
$= 3\pi \times 10^{-7} = 9.42 \times 10^{-7}$

48. Choose the ....
Sol. **(3)**
(1) r + e = 1 these means if r is large (good reflector) then e will be small (bad emitter)
(4) efficiency is equal to 1 - t_1/t_2 (t_1 cannot be zero so, efficiency can not be 100%)

49. In a decay ....
Sol. **(1)**

$\frac{N_0}{5} = N_0 e^{-\lambda t_1}$ ....(i)

$\Rightarrow t_1 = \frac{2\ell n5}{\ell n2} = 2\log_2 5$ (use $\log_a b \cdot \log_b a = 1$)

$N_0 - \frac{9N_0}{10} = N_0 e^{-\lambda t_2}$ ....(ii)

$\Rightarrow t_2 = \frac{2\ell n10}{\ell n2} = 2\log_2 10 = \log_2 100$

(i) / (ii) gives,

$$2 = e^{\lambda(t_2 - t_1)}$$

$\ell n2 = \lambda(t_2 - t_1)$

From graphs $t_{1/2} = 2$ sec.

So, $\lambda = \dfrac{\ell n2}{t_{1/2}} = \dfrac{\ell n2}{2}$

$\ell n2 = (t_2 - t_1)$

$t_2 - t_1 = 2.$

50. Select correct ....

Ans. (4)

51. A source emit ....

Sol. (3)

$$\lambda' = \frac{V - V_s}{f} = \frac{332 - 32}{1000} = 0.3 \text{ m}$$

$$f' = f\frac{(V + V_0)}{V - V_s} = 1000 \times \frac{332 + 64}{332 - 32} = 1320 \text{ Hz}$$

$$\lambda'' = \frac{V - V_0}{f'} = 0.2 \text{ m.}$$

52. $p = \dfrac{a - t^2}{bx}$ ....

Sol. (2)

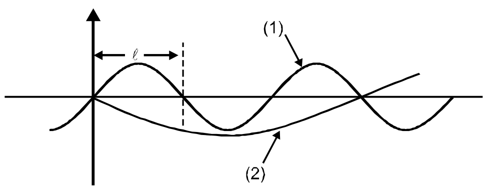
$a = [T^2]$

$$[p] = \frac{[T^2]}{b[L]} \quad ; \qquad b = \frac{[T^2]}{[L]\left[\dfrac{MLT^{-2}}{L^2}\right]}$$

$$\frac{a}{b} = \frac{ML^2T^{-2}}{L^2} = MT^{-2}.$$

53. Two longitudinal ....

Sol. (4)



$$\frac{f_1}{f_2} = \frac{v/2\ell}{v/6\ell} = 3$$

$\Rightarrow f_1 = 3f_2 = 3 \times 2 = 6$ Hz ($\because f_2 = 2$Hz)

$\Rightarrow$ the difference in frequency of the two waves is $= f_1 - f_2 = 6 - 2 = 4$ Hz

54. Three samples ....

Sol. (1)

$N_1\lambda_1 : N_2\lambda_2 : N_3\lambda_3 = 2:5:7$

After two half life

$$\frac{N_1\lambda_1}{2^2} : \frac{N_2\lambda_2}{2^2} : \frac{N_3\lambda_3}{2^2} = 2:5:7$$

55. Density of the ....

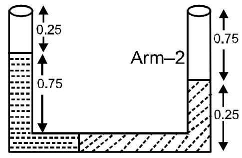
Sol. (3)

For resonance with arm–1

$$f_0 = \frac{V}{4\ell_1}$$

$\Rightarrow \quad \ell_1 = 0.25$ m

For resonance, with arm–2



$$f_0 = \frac{3v}{4\ell_2}$$

$\ell_2 = 0.75$ m

$\rho_0 + \rho_w g(0.75) = \rho_0 + \rho g\,(0.25)$

$\Rightarrow \quad \rho = 3\rho_w$.

56. Now we use a ....

Sol. (2)

For resonance appeared frequency for the tube should be still 300 Hz

$$f' = f_0\left(\frac{V - V_0}{V - V_s}\right)$$

$$300 = 302\left(\frac{300 - 0}{300 - (-V)}\right)$$

V = 2 m/sec away from the tube.

57. The modulation ....

Sol. (2)

$$\mu = \frac{A_m}{A_c} = \frac{20}{30}.$$

58. The lower ....

Sol. (4)

LSB = $f_c - f_m$ = 12 MHz – 12 kHz = 11988000 Hz = 11.988 MHz

59. How many times ....

Ans. (2)

60. If power of sources ....

Sol. (1)

Phase difference at A is 9π (S_2 is lag in phase)

Phase difference at B is 3π (S_1 is lag in phase)

So, 6 times maximum sound can be observed from A to B.

intensity at A $\; I_1 = \dfrac{7200}{4\pi(10)^2} = 18$ watt/m^2

intensity at B $\; I_2 = \dfrac{7200}{4\pi(6)^2} = 50$ watt/m^2

resultant intensity at B

$= I_1 + I_2 + 2\sqrt{I_1 I_2}\cos 5\pi = (\sqrt{50} - \sqrt{18})^2$.

PART-C

CHEMISTRY

61. Which of the following ......

Sol. (3)

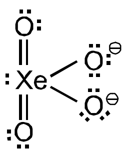
Boron (B_2) : $(\sigma 1s)^2\ (\sigma^*1s)^2\ (\sigma 2s)^2\ (\sigma^*2s)^2\ (\pi 2p^1_x = \pi 2p^1_y)\ (\sigma p_z)^0$

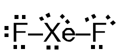
62. Unequal bond lengths ......

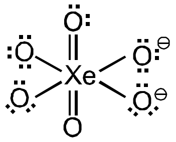
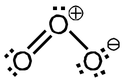
Sol. (3)

63. In which of the following species......

Sol. (2)

(1) 

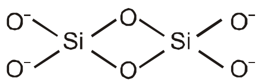
(2)  all three atoms carry 3 lp each

(3)  (4) 

64. Which of the following has ......
Sol. (3)

65. The oxide of an element ......
Sol. (1)
The element is phosphorus.

66. Which of the following statements ......
Sol. (3)
(1) $[Co(NH_3)_4(H_2O)Cl]Br_2$ and $[Co(NH_3)_4Br_2]Cl.H_2O$; ionization as well as hydrate isomers.
(2) $[Co(NH_3)_5(H_2O)](NO_3)_3$ and $[Co(NH_3)_5(NO_3)](NO_3)_2H_2O$ hydrate isomers.
(3) $\underset{Pt(II)}{[Pt(NH_3)_4]^{2+}}\ \underset{Pt(IV)}{[PtCl_6]^{2-}}$ and $\underset{Pt(IV)}{[Pt(NH_3)_4Cl_2]^{2+}}\ \underset{Pt(II)}{[PtCl_4]^{2-}}$
(4) $[Co(NH_3)_4(NO_2)Cl]Cl$; $[Co(NH_3)_4(ONO)Cl]Cl$ linkage isomer and $[Co(NH_3)_4Cl_2]NO_2$ ionization isomer.

67. Usually a disilicate share ......
Sol. (2)
 $= Si_2O_6^{4-} \Rightarrow K_4Si_2O_6$

68. Bubbling CO_2 through ......
Sol. (1)
$2NaAlO_2 + CO_2 + 3H_2O \longrightarrow Na_2CO_3 + 2Al(OH)_3\downarrow$

69. When conc. HNO_3 ......
Sol. (4)
$4HNO_3 + P_4O_{10} \xrightarrow{heat} 2N_2O_5 + 4\ HPO_3$

70. Which is not correctly ......
Sol. (1)

71. A substance X when ......
Sol. (2)

72. An aqueous solution ......
Sol. (1)
In excess of NH_4OH ppt of $Zn(OH)_2$ will get dissolved.

73. (I) When copper ......
Sol. (2)
When copper ore is mixed with silica, in a reverberatory furnace copper matte is produced. The copper matte contains sulphides of copper (I) and iron (II).

74. Among the following ......
Sol. (4)
On heating with concentrated NaOH solution in an inert atmosphere of CO_2, white phosphorus gives PH_3 gas.

75. Which of the following ......
Sol. (4)
$BeF_2 + 2NaF \longrightarrow Na_2[BeF_4]$

76. (I) V_2O_5, Cr_2O_3 ......
Sol. (3)
Interstitial compounds are chemically inert

77. $Na_2S_2O_3.\ 5H_2O$ ......
Sol. (2)
$2Na_2S_2O_3 + \underset{\text{Unexposed}}{AgBr} \longrightarrow Na_3[Ag(S_2O_3)_2] + NaBr$

This property is used for fixing in photography.

Sol. $2Na_2S_2O_3 + \underset{\text{अप्रकाशित}}{AgBr} \longrightarrow Na_3[Ag(S_2O_3)_2] + NaBr$

78. H_2S reacts with lead acetate ......
Sol. (4)
$H_2S + (CH_3COO)_2Pb \longrightarrow \underset{black}{PbS} + 2CH_3COOH$

$PbS + 4H_2O_2 \longrightarrow \underset{white}{PbSO_4} + 4H_2O$

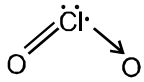
79. (I) $[MnCl_6]^{3-}$, $[FeF_6]^{3-}$ ......
Sol. (2)
I : As all are weak field ligands therefore all will have same number of unpaired electrons as in central metal ion.
II : V.B.T. does not give any interpretation about the relative thermodynamic stabilities of various complexes. This is one of the limitation of V.B.T.
III : is correct statement.

80. When $[K]^+ [AgF_4]^-$ ......
Sol. (1)
$K\ AgF_4 + BF_3 \rightarrow AgF_3 + KBF_4$;
$2AgF_3 + Xe \rightarrow 2AgF_2 + XeF_2$
(red solid) (brown solid)

81. Which of the following ions ......
Sol. (1)

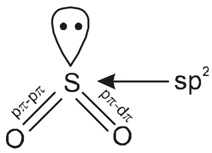
82. Which of the following ......
Sol. (2)
ClO_2 is powerful oxidising agent, also strong chlorinating agent. Its bleaching power is almost 30 times stronger than Cl_2. In alkaline solution undergoes disproportionation.

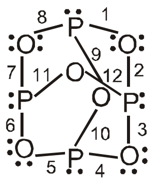
$$2ClO_2 + 2NaOH \longrightarrow NaClO + NaClO_3 + H_2O$$

 unpaired electron that's why paramagnetic.

83. Correct observation ......
Sol. (2)
X : $Fe[Fe(CN)_6]$ Y or Z : $Fe_4[Fe(CN)_6]_3$.

84. Which one is incorrect ......
Sol. (4)
(1) PH_5 does not exist as there is large difference in energies of s, p and d orbitals and hence it does not undergo sp^3d hybridisation.
In SCl_6, smaller S cannnot accomodate six larger Cl^- ions. Fluorine can not expand its octet because it does not have vacant d-orbitals. So FCl_3 does not exist.

(2) 

(3) P_4O_6 

85. **(I)** $[Co(EDTA)]^-$ ......
Sol. (4)
(I), **(II)** and **(III)** are correct statements.
(IV) It is an example of only hydrate isomerism not ionisation isomerism because ionisation isomerism occurs owing to exchange of ions between coordination and ionisation spheres.

86. Identify the least stable ......
Sol. (1)

87. When haematite ore is burnt ......
Sol. (2)

88. Which of the following ......
Sol. (3)

89. In which of the following complex ......
Sol. (3)
In $[Fe(CN)_6]^{4-}$; Fe(II) is $t_{2g}^{\,6}$, eg^0 due to strong ligands.

90. Ammonia, on reaction ......
Sol. (3)
$2NH_3 + OCl^- \longrightarrow N_2H_4 + H_2O + Cl^-$