FIITJEE FARIDABAD

MOCK PRACTICE PAPER FOR

JEE -Advance- 2020

MOCK PRACTICE PAPER-11

Time: 3 hours | ***Maximum marks: 240***

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. This question paper contains Three Parts.
3. **Part-1** is Chemistry, **Part-2** is Physics and **Part-3** is Mathematics.
4. Rough spaces are provided for rough work inside the question paper. No additional sheets will be provided for rough work.
5. Blank Papers, clip boards, log tables, slide rule, calculator, cellular phones, pagers and electronic devices, in any form, are not allowed.

B. Filling of OMR Sheet

1. Ensure matching of OMR sheet with the Question paper before you start marking your answers on OMR sheet.
2. On the OMR sheet, darken the appropriate bubble with HB pencil for each character of your Enrolment No. and write in ink your Name, Test Centre and other details at the designated places.
3. OMR sheet contains alphabets, numerals & special characters for marking answers.

C. Marking Scheme For All Sections.

(i) **Section-A (01 – 7)** contains **7** multiple choice questions which have **only one** correct answer. Each question carries **+3 marks** for correct answer and **-1** for incorrect answer.

(ii) **Section-A (08 – 11)** contains **4** multiple choice questions which have **one or more than one** correct answers. Each question carries **+4 marks** for correct answer and **-2** for incorrect answer.

(iii) **Section-A (12 – 16)** contains **5** comprehension type questions which have **only one** correct answer. Each question carries **+3 marks** for correct answer and **No** negative marking in this section.

(iv) **Section-C (01 – 07)** contains **7** questions. The answer to each question is a single –digit integer, ranging from **0 to 9** (both inclusive). Each question you will be awarded +**4** marks for correct answer and **No** negative marking in this section.

Name of the Candidate :____

Batch :____________________ **Date of Examination :**________________________

Enrolment Number :____

CHEMISTRY

SECTION – I
(SINGLE CORRECT CHOICE TYPE)

This section contains **7 multiple choice questions**. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **ONLY ONE** is correct

1. Identify the correct option

I. $2H-\overset{\overset{\large D}{|}}{C}=O + OH^-(aq) \longrightarrow (P) + Alcohol\,(Q)$

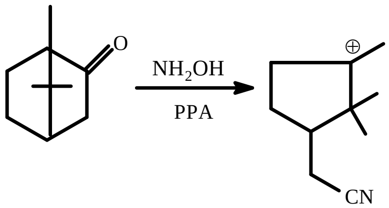
II. $2D-\overset{\overset{\large D}{|}}{C}=O + OH^-(aq) \longrightarrow (R) + Alcohol\,(S)$

	P	Q	R	S
A)	$DCOO^-$	CH_2DOH	$DCOO^-$	CH_2DOH
B)	$HCOO^-$	CH_3OH	$HCOO^-$	CD_3OH
C)	$HCOO^-$	CH_2DOH	$HCOO^-$	CH_2DOH
D)	$DCOO^-$	CH_2DOH	$DCOO^-$	CD_3OH

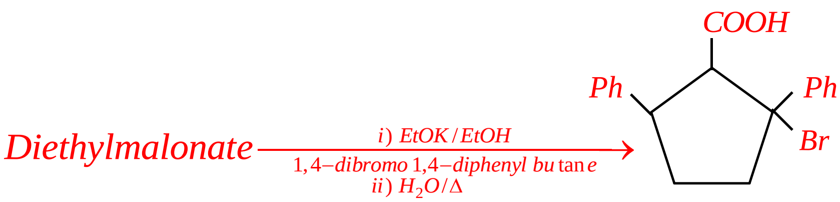
2. Select the reaction(s) which do not relate to the corresponding product (or) intermediate mentioned against them

1) $CH_3-(CH_2)_{10}-CONH_2 \xrightarrow[\Delta]{Br_2/NaOH} CH_3-(CH_2)_{10}-CH_2-NH_2$

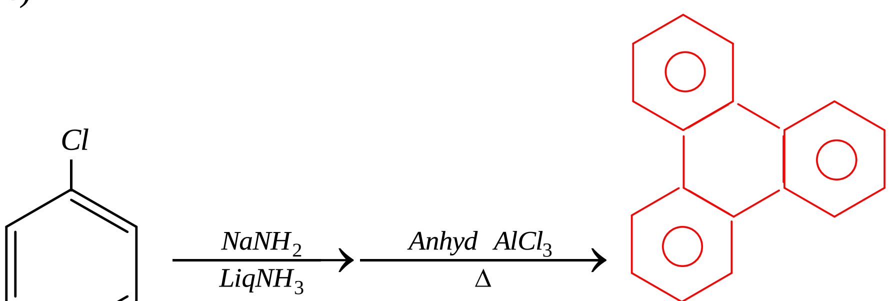
2)



3)



4)



(Tryptycene)

A) 1 and 4 B) 2 and 3 C) 1 and 3 D) only 3

3. 20 ml of H_2O_2 solution on reaction with excess acidified $KMnO_4$ released 224 c.c. of O_2 at S.T.P. Then the incorrect statement is:

A) the volume of H_2O_2 strength is 5.6

B) the (w/V) % strength of H_2O_2 is 1.7

C) the normality of H_2O_2 is 0.5

D) Equivalent weight of O_2 in the above reaction is 16

4. Limiting molar conductivity of HCOOH is given by [Given limiting molar conductivity of $H_2SO_4 = x_1; Al_2(SO_4)_3 = x_2 \,\&\, Al(HCOO)_3 = x_3$ (Assume 100% dissociation of salt and no hydrolysis of ions)

A) $6x_1 - 3x_2 + 6x_3$ B) $\frac{x_1 - x_2 + x_3}{6}$ C) $\frac{3x_1 - x_2 + 2x_3}{6}$ D) $\frac{6x_1 - 3x_2 + 6x_3}{6}$

5. Which of the following oxoanion have least tendency to undergo polymerization?

A) SO_4^{2-} B) ClO_4^{-} C) PO_4^{3-} D) SiO_4^{4-}

6. Which of the following paramagnetic complexes with + 2 oxidation state of central metal shows geometrical isomerism?

A) $[Cr(en)_2(NO_2)_2]Cl$ B) $[Ni(en)_3]Cl_2$

C) $[Co(NH_3)_4(H_2O)_2]Cl_2$ D) $[Pt(NH_3)_2Cl_2]$

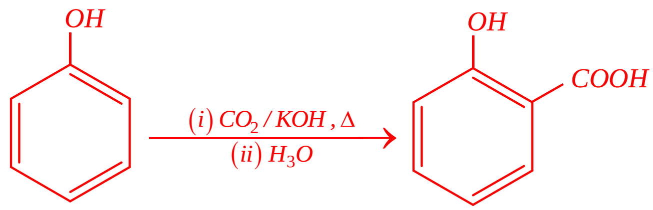
7. Cation which is not precipitated by H_2S neither in acidic medium nor in basic medium?

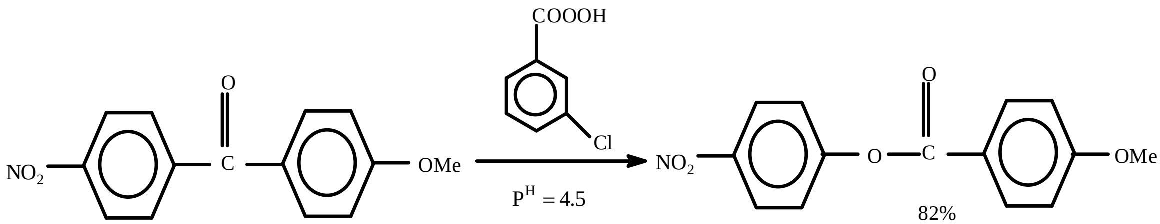
A) Bi^{3+} B) Pb^{2+} C) Ba^{2+} D) Mn^{2+}

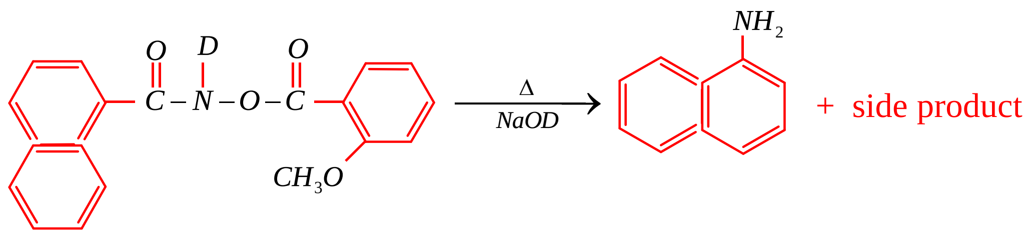
SECTION – II
(MORE THAN ONE TYPE)

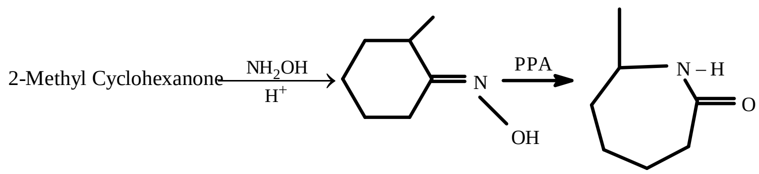
This section contains 4 **multiple choice questions**. Each question has four choices a), b), c), d) out of which **ONE OR MORE** may be correct.

8. Select correctly matched product(s) (only major)

A)


B)


C) 

D) 

9. If x and y are arbitrary extensive variables, then

A) $(x+y)$ is an extensive variable B) $\frac{x}{y}$ is an intensive variable

C) $\frac{dx}{dy}$ is an intensive variable D) (x-y) is an extensive variable

10. Which of the following statement(s) is/are correct about borax?

A) produce buffer solution in water

B) used as a flux

C) produce alkaline solution in water

D) produce blue bead on heating with $MgSO_4$

11. In which of the following options the same gas is not released as one of the product in both the reactions given (other than water vapour)?

A) $Zn + dil\, H_2SO_4 \longrightarrow$; $\quad Cu + dil\ HNO_3 \longrightarrow$

B) $NH_4Cl \xrightarrow{NaOH(aq)}$; $\quad NaNO_3 \xrightarrow[NaOH]{Devarda's\ alloy}$

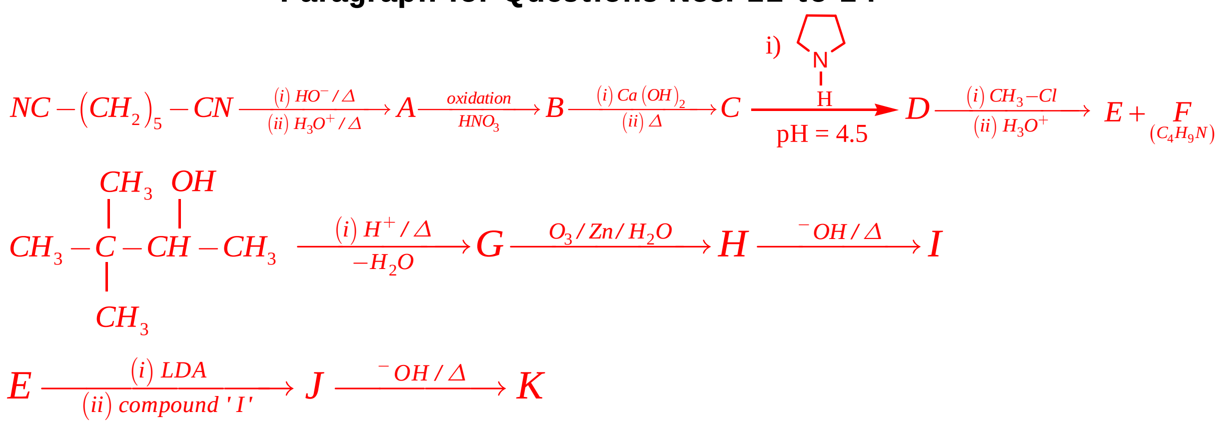
C) $NH_4NO_3 \xrightarrow{\Delta}$; $\quad (NH_4)_2Cr_2O_7 \xrightarrow{\Delta}$

D) $Mg_2C_3 + H_2O \longrightarrow$; $\quad Al_4C_3 + H_2O \longrightarrow$

SECTION – III
(PARAGRAPH TYPE)

This section contains 2 **paragraphs.** Each of these questions has four choices a), b), c) and d) out of which ONLY ONE is correct

Paragraph for Questions Nos. 12 to 14



12. Formation of final compound 'K' from the given sequences involve

i) Cyclisation ii) Aldol condensation iii) Conjugate addition

iv) Elimination v) Decarboxylation

A) only i and iii B) only iii, iv and v

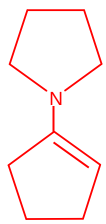
C) only i, ii, iii and iv D) i, ii, iii, iv, and v

13. Which of the following is correct statement?

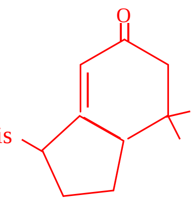
A) “B” is Adipic acid B) “C” is a cyclic ketone

C) “I” is mesitylene oxide D) All are correct

14. Which of the following are correctly matched?

i) 'D' is 

ii) H is $CH_3-\overset{\overset{O}{||}}{C}-CH_3$

iii) K is 

A) only i and ii B) only ii and iii

C) only i and iii D) All i, ii and iii

Paragraph for Questions Nos. 15 to 16

The heats of formation of the oxides of third period elements are as shown (in kJ/mole)

Na_2O	MgO	Al_2O_3	SiO_2	P_4O_{10}	SO_3	Cl_2O_7
–416	–602	–1676	–911	–2984	–395	+250

15. Which oxide has maximum negative heat of formation per oxygen atom?

A) P_4O_{10} B) Al_2O_3 C) Na_2O D) MgO

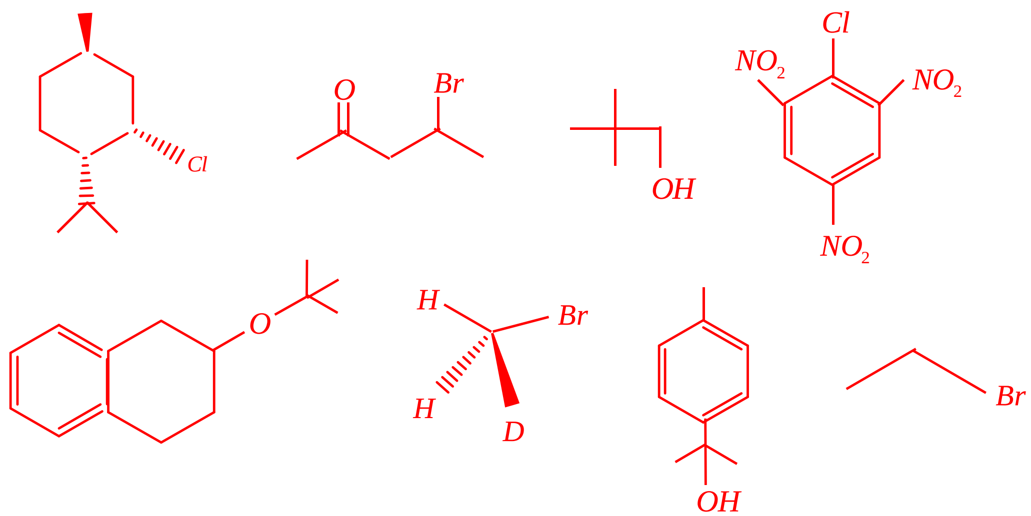
16. Most stable and least stable oxides are respectively:

A) P_4O_{10}, Cl_2O_7 B) Na_2O, Cl_2O_7 C) Al_2O_3, Cl_2O_7 D) MgO, Cl_2O_7

SECTION – IV
INTEGER TYPE

(This section contains **7 questions.** The answer to each question is a single digit integer ranging from 0 to 9. The correct digit below the question number in the ORS is to be bubbled)

1. How many of the following compound(s) can undergo E_2 or SN_1 or E_1CB under suitable conditions?



2. A hexapeptide has composition Ala, Gly, Phe, Val_3. Both N – terminal and C – terminal units are *Val* and, no *Val*-*Val* peptide bond is present. If x is the total primary structures of hexapeptides possible , which satisfy these conditions, then the value $\frac{x}{2}$ is___

3. MX_n dissociates into M^{+n} & X^- ions in aqueous solution, with a degree of dissociation of 2/3. The ratio of observed elevation in boiling point of the aqueous solution to the value of elevation in boiling point in the absence of ionic dissociation is 3, then 'n' is

4. The atomic mass of H_2 and He are 2 amu & 4 amu respectively. The value of the debroglies wavelength of H_2 gas at -173^0C is 'x' times that of the debroglie wavelength of "He" at -73^0C, then x is____

5. How many of the following minerals contain carbonate anion?

cinnabar, calamine, feldspar, beryl, gibbsite, tinstone, siderite and cerrussite

6. Number of S – S bonds present in the cyclic trimer of $SO_3(\gamma-SO_3)$ is:

7. Among $N_2O_5, NO_2, XeF_4, XeF_6, Cl_2O_6$ and XeF_2, the number of compounds undergoes disproportionation during their complete hydrolysis only with water is:

PHYSICS

SECTION – I
(SINGLE CORRECT CHOICE TYPE)

This section contains **7 multiple choice questions**. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **ONLY ONE** is correct

1. A short electric dipole of dipole moment $p\hat{i}$ is placed at origin in xy-plane. The locus of equi-potential surface around the dipole if a constant external electric field $E\hat{i}$ also exists throughout the space is $\left(k = \dfrac{1}{4\pi\varepsilon_0}\right)$

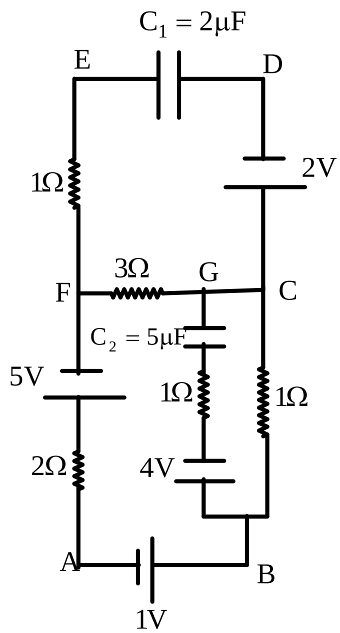
A) $x^2 + y^2 + z^2 = \left(\dfrac{kp}{E}\right)^{2/3}$

B) $x^2 + y^2 = \left(\dfrac{kp}{E}\right)^{2/3}$

C) $x^2 + y^2 + z^2 = \left(\dfrac{kp}{E}\right)^{1/3}$

D) $x^2 + y^2 = \left(\dfrac{kp}{E}\right)^{1/3}$

2. For the given circuit in steady state, the potential drop across the capacitor C_2 is



A) zero B) 1V C) 3V D) 4V

3. A physical quantity 'X' is given by $X = \varepsilon_0 A E l$, where ε_0 is permittivity of free space, A is area, E is electric field intensity and 'l' is length. The dimensional formula for 'X' is same as that of

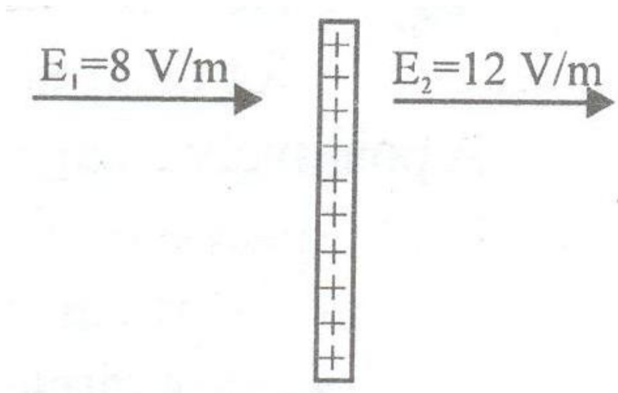
A) Electric Charge B) Electric Current

C) Electric dipole moment D) Electric Potential

4. An infinite long straight solid cylindrical conductor of radius a is surrounded by a coaxial infinite conducing jacket of radius b. Assuming current flows uniformly through the cross section of the cylinder and returns through the jacket, the inductance per unit length for this arrangement is

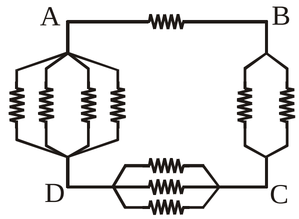
A) $\frac{\mu_0}{2\pi}\ln(b/a)$ B) $\frac{\mu_0}{4\pi}$ C) $\frac{\mu_0}{2\pi}\left(\frac{1}{2}+\ln\frac{b}{a}\right)$ D) $\frac{\mu_0}{2\pi}\left(\frac{1}{4}+\ln\frac{b}{a}\right)$

5. The electric field on two sides of a charged plate is shown in the figure. The surface charge density on the plate is given by:



A) $2\varepsilon_0$ B) $4\varepsilon_0$ C) $10\varepsilon_0$ D) zero

6. Ten equal resistances are connected as shown in the figure. A battery is to be so connected that the power developed in the circuit is maximum. The battery should be connected between



A) A and B B) B and C C) C and D D) D and A.

7. Consider two arbitrary decay equations and mark the correct alternative(s) given below.

(i) ${}^{230}_{92}\text{U} \rightarrow n + {}^{229}_{92}\text{U}$ (ii) ${}^{230}_{92}\text{U} \rightarrow p + {}^{229}_{91}\text{Pa}$

Given $\text{M}\left({}^{230}_{92}\text{U}\right)$ = 230.033927 u

$\text{M}\left({}^{229}_{92}\text{U}\right)$ = 229.03349 u

m_n = 1.008665 u

m_p = 1.007825

1 amu = 931.5 MeV.

A) Only decay (i) is possible B) Only decay (ii) is possible

C) Both the decays are possible D) Neither of the two decays is possible.

SECTION – II
(MULTIPLE CORRECT CHOICE TYPE)

This section contains **4 multiple choice questions**. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **ONE OR MORE** is/ are correct

8. The resistivity of a cylindrical conductor carrying steady current along its length varies linearly with the distance from the current carrying end as given by $\rho = \rho_0\left(1+\frac{x}{l}\right)$ where l is the length of the conductor and x is the distance from the current entry end. ρ_o is a positive constant.

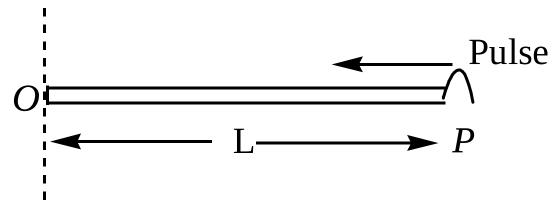
A) Electric field varies linearly with x

B) Electric potential difference across the length x varies linearly with x

C) Volume charge density in the conductor is zero

D) volume charge density in the conductor is non zero.

9. A metallic rod of length L, linear mass density μ rotates about one of it's end 'O' in a smooth horizontal plane with an angular velocity ω about an end axis which is perpendicular to plane of rotation shown in figure. A transverse pulse generated at the free end P to reach the axis of rotation. (neglect the gravitational effect)



A) The speed of the transverse pulse just after generated at the free end point P with respect to ground is $L\omega$

B) The speed of the transverse pulse when it reaches the midpoint of metallic rod with respect to ground is $\frac{\sqrt{5}L\omega}{\sqrt{8}}$

C) The tension in the metallic rod at a distance 'x' from the free end $\frac{\mu\left[L^2-(L-x)^2\right]}{2}\omega^2$

D) The time taken by the transverse pulse to reach the axis of rotation from the free end is $\frac{\pi}{\sqrt{2}\omega}$

10. In a vernier callipers with no zero error, 7^{th} division of main scale coincides with 10^{th} division of vernier scale when nothing is kept between the calipers (Take 1 MSD = 1mm)When a rod of length ℓ, is kept between the calipers, it is found that zero of the vernier lies between the 9^{th} and 10^{th} divisions of main scale and 4^{th} division of the vernier coincides with 12^{th} division of main scale.

A) $\ell = 9.2\text{mm}$ B) $\ell = 10.2\text{mm}$

C) Least count = 0.3mm D) vernier constant = 0.3mm

11. A ray travelling in air $(\mu = 1)$ is incident on a spherical body (μ = $\sqrt{3}$) making an angle 60° with the normal drawn at that point. The ray after passing through sphere gets incident on the further surface of sphere and gets reflected and refracted. Then choose the correct alternative

A) The angle of refraction at first surface is 60°

B) The angle of refraction at first surface is 30°

C) The angle of incidence at second surface is 30°

D) The angle between reflected ray and refracted ray at second surface is 90°.

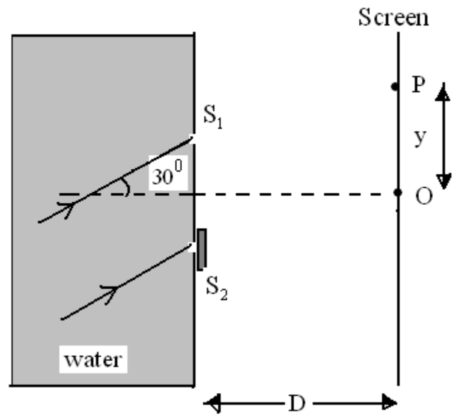
SECTION – III

(COMPREHENSION TYPE)

This section contains 2 groups of questions. Each group has 2&3 multiple choice questions based on a paragraph. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **ONLY ONE** is correct.

Paragraph for Questions Nos. 12 to 14

In Young's double slit experiment, the two slits are covered with transparent membranes of negligible thickness which allows light to pass through it but not allow water. A glass slab of thickness 0.41mm and refractive index 1.5 is placed infront of one of the slits as shown in figure. The separation between the slits d = 0.30mm. The entire space to the left of the slits is filled with water of refractive index 4/3. A coherent light of intensity 'I' and absolute wavelength 500nm is being incident on the slits making an angle of 30^0 with horizontal. Screen is placed at a distance of 1m from the slits. Based on the given information, answer 35,36 and 37questions. (take d<< D)



12. At a point 'O' equidistant from the slits we get

A) 9^{th} dark fringe B) 10^{th} dark fringe

C) 11^{th} bright fringe D) 10^{th} bright fringe

13. Central maxima is located at

A) $y = +\frac{5}{6}\text{cm}$ B) $y = -\frac{5}{6}\text{cm}$

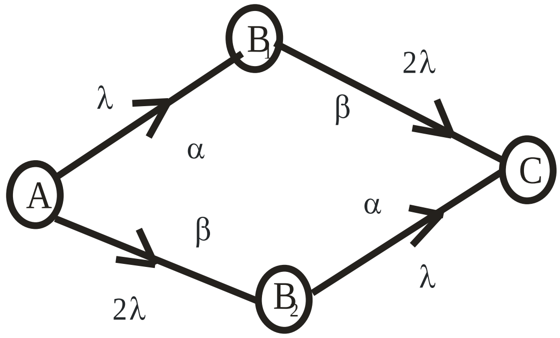
C) $y = +\frac{5}{3}\text{cm}$ D) $y = -\frac{5}{3}\text{cm}$

14. The ratio of intensity at point P at $y = \frac{1}{8}\text{cm}$ on the screen and maximum intensity is

A) 0 B) 1 C) $\frac{1}{\sqrt{2}}$ D) $\frac{1}{2}$

Paragraph for Questions Nos. 15 to 16

A hypothetical decay chain consists of the following elements A, B_1 , B_2 and C where C is stable. The decay constants are λ and 2λ for α and β decays of A . They are 2λ and λ for β and α decays of B_1 and B_2 leading to the formation of C as shown in the figure. {Initial number of atoms of A is N_0}



15. At some instant when number of atoms of B_1 and B_2 reaches a maximum value, the ratios of number of atoms $\frac{N_{B_1}}{N_A}$ and $\frac{N_{B_2}}{N_A}$ at that instant is found to be x and y. The product xy =

A) 1 B) 1/4 C) 3/2 D) ¾

16. The number of atoms of A as a function of time is

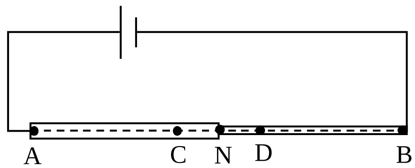
A) $N_0e^{-5\lambda t}$ B) $N_0e^{-\lambda t}$ C) $N_0e^{-2\lambda t}$ D) $N_0e^{-3\lambda t}$

SECTION –IV
(INTEGER ANSWER TYPE)

This section contains 7 questions . The answer to each of the questions is a single digit integer, ranging from 0 to 9. The appropriate bubbles below the respective question numbers in the ORS have to be darkened.

1. A helium atom is de-excited from an energy level 'n' to ground state emitting two consecutive photons of wavelengths 108.5nm and 30.4nm. Find 'n'.

2. The potentiometer wire AB is made of two equal parts AN and NB of cross sectional radii 2r and r respectively. The material of both parts is same. A cell is connected between A and B. The potential gradient in the part AN is 1 V/m. Potential difference between two points C and D (shown in figure) separated by 20 cm is found to be 0.5V. The separation between C and N is ’2x’ cm . Find the value ‘x’.

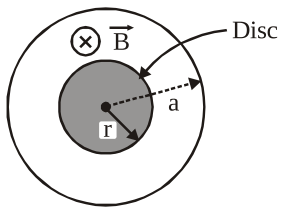


3. In a nuclear reactor an element X decays to a radioactive element Y at a constant rate 10^{15} atoms per sec. Each decay releases 100 MeV energy. Half life of Y equals T and decays to a stable product Z. Each decay of Y releases 50 MeV. All energy released inside the reactor is used to produce electricity at an efficiency of 25%. Calculate the electrical power in kw generated in the reactor in steady state.

4. A church bell is struck once and the sound energy dies away with a half life of 2.0 s. The energy of an oscillating system is proportional to the square of the amplitude of oscillation. The resonant frequency of the bell is 225 Hz. If the number of oscillations before the amplitude falls to ¼ of the initial amplitude is 300n, find the value of ‘n’.

5. The ends of a stretched wire of length 'L' are fixed at x=0 and x=L. In one experiment the displacement of a point of the wire is $y_1 = A\sin\left(\frac{\pi x}{L}\right)\cos\omega t$ and energy E_1 and in another experiment the displacement of a point of the wire is $y_2 = 2A\sin\left(\frac{4\pi x}{L}\right)\sin 3\omega t$ and energy is E_2. It is found that $E_2 = n^2 E_1$. Find the value of 'n'.

6. A uniform disc of radius r and mass m is charged uniformly with the charge q. This disc is placed flat on a rough horizontal surface having coefficient of friction μ. A uniform magnetic field is present in a circular region (a > r) but varying as kt^3 as shown in figure. Find the time in second after which the disc begins to rotate. (Given r = 1 m, m = 18 kg, q = 1C, μ = 0.1, K = 4, g = 10 m/s^2)



7. An $\alpha-$particle is moving along a circle of radius 10cm with angular speed 'ω'. Point A lies in the plane of the circular path at a distance 20cm from the centre of the circle. Point 'A' records zero magnetic field in a minimum time interval of $\frac{\pi}{6}$sec produced by the moving $\alpha-$particle. Find the angular speed 'ω' of the particle.

MATHEMATICS

SECTION – I
(Straight Objective Type)

This section contains 7 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE** is correct.

1. Suppose that z is any complex number which is not equal to any of $\{3, 3\omega, 3\omega^2\}$ where ω is a complex cube root of unity. Then $\frac{1}{z-3}+\frac{1}{z-3\omega}+\frac{1}{z-3\omega^2}$ equals

A) $\frac{3z^2+3z}{(z-3)^3}$ B) $\frac{3z^2+3\omega z}{z^3-27}$ C) $\frac{3z^2}{z^3-3z^2-27}$ D) $\frac{3z^2}{z^3-27}$

2. A diagonal of rhombus ABCD is member of both families of lines $(x+y-1)+\lambda(2x+3y-2)=0 \,\&\, (x-y+2)+\mu(2x-3y+5)=0$ where $\lambda \,\&\, \mu$ are real parameters and one vertex of rhombus is (3, 2). If area of rhombus be $12\sqrt{5}$ sq.units ,then the length of the longer diagonal is

A) 6 B) 8 C) 10 D) 12

3. Equation of the hyperbola touching x-axis and having points S (2, 4) and S^1 (8, -2) as its foci, is

A) $\frac{(x+y-6)^2}{10}-\frac{(x-y-4)^2}{8}=1$ B) $\frac{(x-y-4)^2}{10}-\frac{(x+y-6)^2}{8}=1$

C) $\frac{(x-y-4)^2}{20}-\frac{(x+y-6)^2}{16}=1$ D) $\frac{(x+y-6)^2}{20}-\frac{(x-y-4)^2}{16}=1$

4. If $\sqrt{2}\cos A = \cos B + \cos^3 B$, $\sqrt{2}\sin A = \sin B - \sin^3 B$,then $|\sin(A-B)|$ is equal to

A) 1/2 B) 1/3 C) 2/3 D) 1/5

5. If $\vec{a}, \vec{b}$ be two perpendicular unit vectors such that $\vec{x} = \vec{b} - (\vec{a} \times \vec{x})$, then $|\vec{x}|$ is equal to

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

6. If $t_n = \sum_{r=0}^{n} \frac{1}{({}^{n}C_r)^k}$ and $S_n = \sum_{r=0}^{n} \frac{r}{({}^{n}C_r)^k}$,where $k \in N$, then $\cos^{-1}\left(\frac{S_n}{nt_n}\right)$ is

A) $\frac{\pi}{6}$ B) $\frac{\pi}{3}$ C) $\frac{\pi}{4}$ D) $\frac{\pi}{2}$

7. Let B = $A^3 - 2A^2 + 3A - I$, where I is a identity matrix and A = $\begin{bmatrix} 1 & 3 & 2 \\ 2 & 0 & 3 \\ 1 & -1 & 1 \end{bmatrix}$ then the transpose of matrix B is equal to

A) $\begin{bmatrix} 8 & 14 & 7 \\ 21 & 1 & -7 \\ 14 & 21 & 8 \end{bmatrix}$ B) $\begin{bmatrix} 2 & 21 & 14 \\ 14 & 1 & 21 \\ 7 & -7 & 8 \end{bmatrix}$ C) $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ D) $\begin{bmatrix} 3 & 1 & 0 \\ 1 & 1 & 0 \\ 3 & 1 & 0 \end{bmatrix}$

SECTION – II

Multiple Correct Answer Type

This section contains 4 multiple correct answer(s) type questions. Each question has 4 choices (A), (B), (C) and (D), out of which **ONE OR MORE** is/are correct.

8. Let $\left(1+x^2\right)^2\left(1+x\right)^n=\sum_{K=0}^{n+4}a_Kx^K$.If a_1,a_2,a_3 are in AP ,then n can be (given that ${}^nC_r=0,\text{if } n<r$)

A) 6 B) 4 C) 3 D) 2

9. Identify the **CORRECT Statement(s):**

A) If angle θ between the line $\frac{x+1}{1}=\frac{y-1}{2}=\frac{z-2}{2}$ and the plane $2x-y+\sqrt{\lambda}z+4=0$ is such that $\sin\theta=\frac{1}{3}$,then the value of λ is $\frac{5}{3}$

B) A tetrahedron has vertices $O(0,0,0), A(1,2,1), B(2,1,3)$ and $C(-1,1,2)$, then angle between faces OAB and ABC will be $\cos^{-1}\left(\frac{19}{35}\right)$

C) Number of divisors of $2^2.3^3.5^3.7^5$ of the form 4n + 1, n $\in$N is 48

D) Let a, b be arbitrary real numbers, then the smallest natural number b for which the equation $x^2+2(a+b)x+(a-b+8)=0$ has unequal real roots for all $a\in R$, is 5.

10. Identify the **CORRECT Statement(s):**

A) An ellipse passes through the point (4, –1) and touches the line x + 4y - 10 = 0. If its axes coincide with the coordinate axes, then its equations is $\frac{x^2}{80}+\frac{y^2}{5/4}=1$

B) In the expansion of $\left(\sqrt[3]{4}+\frac{1}{\sqrt[4]{6}}\right)^{20}$, there are 19 irrational terms

C) The set S = {1, 2, 3, ..., 12} is to be partitioned into three sets A, B, C of equal size such that $A\cup B\cup C=S, A\cap B=B\cap C=A\cap C=\phi$ .The number of ways to partition S is $\frac{12!}{(4!)^3}$

D) If the normal at $\left(ct_1,\frac{c}{t_1}\right)$ on $xy=c^2$ meets it again in the point $\left(ct_2,\frac{c}{t_2}\right)$, then $t_1^3t_2=1$

11. If $f(x)=\int_1^x \frac{\ln t}{1+t}dt,$ then

A) $f\left(\frac{1}{x}\right)=-\int_1^x \frac{\ln t}{t(1+t)}dt$

B) $f\left(\frac{1}{x}\right)=\int_1^x \frac{\ln t}{t(1+t)}dt$

C) $f\left(\sqrt{e}\right)+f\left(\frac{1}{\sqrt{e}}\right)=\frac{1}{8}$

D) $f(x)+\left(\frac{1}{x}\right)=\frac{1}{2}(\ln x)^2$

SECTION – III

[Linked Comprehension Type]

This section contains 2 paragraphs. Based upon one of paragraphs 2 multiple choice questions and based on the other paragraph 3 multiple choice questions have to be answered. Each of these questions has four choices (A), (B),(C) and (D) out of which **ONLY ONE** is correct.

Paragraph for Questions Nos. 12 to 13

Let $S = S_1 \cap S_2 \cap S_3$, where $z = x + iy, x, y \in \mathbb{R}$

$S_1 = \{z \in \mathbb{C} : |z| < 4\}$, $S_2 = \left\{z \in \mathbb{C} : \operatorname{Im}\left[\frac{z - 1 + \sqrt{3}i}{1 - \sqrt{3}i}\right] > 0\right\}$ and $S_3 = \{z \in \mathbb{C} : \operatorname{Re}(z^2) > 0\}$.

12. Area of S is ……. Square units.

A) $\frac{10\pi}{3}$ B) 4π C) $\frac{20\pi}{3}$ D) $\frac{32\pi}{3}$

13. $\min\limits_{z \in S} |1 - 3i - z| =$

A) $\frac{2 - \sqrt{3}}{2}$ B) $\frac{2 + \sqrt{3}}{2}$ C) $\sqrt{2}$ D) $\frac{3 - \sqrt{3}}{2}$

Paragraph for Questions Nos. 14 to 16

Let $A\left(\frac{1}{2}, 0\right), B\left(\frac{3}{2}, 0\right), C\left(\frac{5}{2}, 0\right)$ be the given points and P be a point satisfying

max $\{PA + PB, PB + PC\} < 2$

14. All points P lie in the region bounded by

A) two ellipses
B) two hyperbolas
C) a circle and an ellipse
D) a circle and an hyperbola

15. The locus of P is symmetric about

A) origin
B) the line y = x
C) y-axis
D) x-axis

16. Which of the following is not a possible position of P.

A) $\left(\frac{3}{2},0\right)$
B) $\left(\frac{3}{2},\frac{1}{2}\right)$
C) $\left(\frac{3}{2},\frac{1}{4}\right)$
D) $\left(\frac{3}{2},\frac{\sqrt{3}}{2}\right)$

SECTION – IV
(INTEGER ANSWER TYPE)

This section contains 7 questions Answer to each of the questions is a single digit integer ranging from '0' to '9'. The bubble corresponding to the correct answer is to be darkened in the ORS.

1. If the value of the definite integral $\int_0^{\frac{\pi}{6}} \frac{\sqrt{1+\sin x}}{\cos x} dx$ is equal to $\sqrt{2}\ln\left(\sqrt{A}+\sqrt{B}-\sqrt{C}-\sqrt{D}\right)$

then $A+B-C-D=$

2. If $\int_1^2 \frac{(x^2+1)\sin^2 \pi x}{x^2-2x+3}dx + \int_0^2 \frac{x\sin^2 \pi x}{x^2-2x+3}dx - 2\int_1^2 \frac{x\sin^2 \pi x}{x^2-2x+3}dx = \frac{p}{q}$ (p and q are relatively prime).

Then p + q is equal to.

3. Let a, b be arbitrary real numbers. Find the smallest natural number b for which the equation $x^2+2(a+b)x+(a-b+8)=0$ has unequal real roots for all $a \in R$

4. If the value of $\int_0^8 \left(\sqrt{\cot^{-1}(\cot \pi x)} + \cot^{-1}\left(\cot \pi\sqrt{x}\right)\right)dx = a\sqrt{\pi} + \left(2a\sqrt{2}-b\right)\pi$,then

$3a-b =$ ....

5. If α, β are two distinct real roots of the equation $ax^3+x-1-a=0, (a \neq -1, 0)$, none of which is equal to unity, then the value of $\lim_{x\to\frac{1}{\alpha}} \frac{(1+a)x^3-x^2-a}{\left(e^{1-\alpha x}-1\right)(x-1)}$ is $\frac{am(n\alpha-\beta)}{\alpha}$,

where mn = ...

6. If the area of the region bounded by the curve $C: y = \tan x$, the tangent drawn to C at $x = \pi/4$ and the x-axis is $\frac{k}{10}\left(\ln 2 - \frac{1}{2}\right)$, then find the value of k.

7. Let $A\left(2\hat{i}+3\hat{j}+5\hat{k}\right), B\left(-\hat{i}+3\hat{j}+2\hat{k}\right)$ and $C\left(\lambda\hat{i}+5\hat{j}+\mu\hat{k}\right)$ be the vertices of triangle ABC and the median through A is equally inclined to the positive directions of the axes, then the value of $(2\lambda-\mu)$ is equal to.....

ANSWER KEY

CHEMISTRY		PHYSICS		MATHEMATICS	
1	D	1	A	1	D
2	C	2	C	2	D
3	C	3	C	3	C
4	C	4	D	4	B
5	B	5	B	5	C
6	C	6	D	6	B
7	C	7	D	7	A
8	D	8	AD	8	BCD
9	ABCD	9	ABCD	9	ABCD
10	ABC	10	AD	10	ABC
11	ACD	11	BCD	11	BCD
12	D	12	D	12	B
13	D	13	D	13	C
14	D	14	D	14	A
15	D	15	A	15	D
16	D	16	D	16	D
1	6	1	5	1	7
2	6	2	5	2	3
3	3	3	6	3	5
4	2	4	6	4	5
5	3	5	6	5	1
6	0	6	2	6	5
7	3	7	4	7	2

CHEMISTRY

2. Rate determining steps

3

$$5H_2O_2 + 2KMnO_4 + 6HCl \rightarrow 2KCl + 2MnCl_2 + 8H_2O + 5O_2$$

$$5\,\text{moles}\,H_2O_2 \rightarrow 5\,\text{mole}\,O_2$$

$$1 \rightarrow 22400\,C.C$$

$$0.01 \rightarrow 224\,C.C$$

$$10\,\text{m.moles} \rightarrow 224\,C.C\,O_2$$

$$\therefore \frac{10\,\text{m.moles}}{20\,\text{ml}} \Rightarrow \boxed{M_{H_2O_2} = \frac{1}{2}}$$

5. ClO_4^-

6. $\left[Ni(en)_3\right]^{2+}$ - does not exhibit geometrical isomerism

$\left[Pt(NH_3)_2Cl_2\right]$ - diamagnetic

$\left[Cr(en)_2(NO_2)_2\right]Cl$ - Cr^{3+}

7. Ba^{2+}

8. Mechanistic pathway

10. Borax bead test – performed by coloured salts only

11. a) N_2O, NO b) NH_3, NH_3 c) N_2O, N_2 d) C_3H_4, CH_4

17. methyl halides do not undergo SN1

19. 3

Sol: $\alpha = \dfrac{i-1}{n-1}$

$$\frac{2}{3} = \frac{3-1}{n-1} \Rightarrow (n-1) = \frac{6}{2} = 3$$

$$\therefore n = 3+1 = 4$$

$$m^{+n} + nx^- = 4$$

$$1 + n = 4$$

$$\therefore n = 3$$

20. 2

Sol: $\dfrac{\lambda_1}{\lambda_2} = \dfrac{m_2v_2}{m_1v_1}$ $\qquad \dfrac{\lambda_{H_2}}{\lambda_{He}} = \dfrac{4}{2} \times \dfrac{\sqrt{\frac{200}{4}}}{\sqrt{\frac{100}{2}}}$ $\qquad \therefore \lambda_{H_2} = 2\lambda_{He}$

21. Calamine, siderite, cerrusite

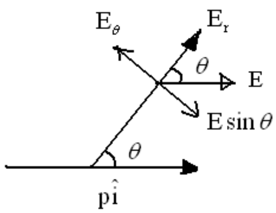
22. zero

23. NO_2, XeF_4, Cl_2O_6

PHYSICS

24. Key: A

Hint: For E.P.S. the normal component of electric field vector to position vector should be zero.



$E_\theta = E\sin\theta$

$\frac{kp\sin\theta}{r^3} = E\sin\theta$

$r = \left(\frac{kp}{E}\right)^{2/3}$

$x^2 + y^2 + z^2 = \left(\frac{kp}{E}\right)^{2/3}$

25. Key: C

Hint: From the loop- ABCGFA we have

$+1 - i - 3i + 5 - 2i = 0$

$\Rightarrow i = 1A$

From the loop- BCGB we have

$-1\times1 + V_{C_2} + 4 = 0$

$V_{C_2} = -3V$

P.D.=3V

26. Key: C

Hint: Conceptual.

27. KEY:(4)

Hint: Calculate L from $L = \frac{1}{\mu_0 i^2}\int B^2 dv$

Not from $L = \frac{\phi_{\text{total}}}{i}$. Because in the given geometry the contour bounded by i is not well defined.

28 CONCEPTUAL

29. Key: D

Hint: For maximum power, equivalent resistance should be minimum.

30. KEY: (D)

For decay (i) Q = [230.033927 – 229.033496 – 1.008665] × 931.5

= –7.7 MeV

For decay (ii) Q = [230.033927 – 299.032089 – 1.007825] × 931.5

= – 5.6 MeV

$\therefore$ Q is negative for both the decay, so none of the decays are allowed. $\therefore$ (D)

31. KEY: (A,D)

$$\vec{J} = \frac{\vec{E}}{\rho} \Rightarrow \vec{E} = \rho_0 J\left(1+\frac{x}{l}\right)$$

Let charge density $=\sigma$

$$dE\cancel{A} = \frac{\sigma \cancel{A} dx}{\epsilon_0}$$

$$\sigma = \epsilon_0 \frac{dE}{dx} = \epsilon_0 J \frac{\rho_0}{l}$$

32. Key: (A,B,C,D)

Tension $= \frac{\mu\left(L^2 - (L-x)^2\right)\omega^2}{2}$ where x is the distance from the free end

Transverse velocity of pulse w.r.t to the string $= \omega\sqrt{\frac{L^2-(L-x)^2}{2}}$

Transverse velocity of pulse at the free end $= l\,\omega$

Transverse velocity of pulse at the mid of string $= \sqrt{\frac{3l^2\omega^2}{8} + \frac{l^2\omega^2}{4}} = \sqrt{\frac{5}{8}}l\omega$

$$\frac{dx}{dt} = \frac{\omega}{\sqrt{2}}\sqrt{L^2 - (L-x)^2}$$

$$\int \frac{\sqrt{2}dx}{\omega\sqrt{L^2 - (L-x)^2}} = \int_0^t dt$$

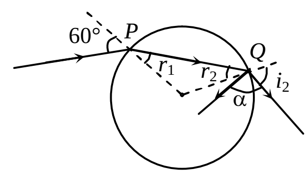
$$t = \frac{\pi}{\sqrt{2}\,\omega}$$

33. Key (A,D)

Least count is not always 1M.S.D-1 V.S.D

34. Key: (B,,C,D)

34. At P



$$\frac{\sin 60}{\sin r_1} = \sqrt{3}$$

$r_1 = 30° = r_2$

$$\frac{\sin i_2}{\sin r_2} = \sqrt{3}$$

$i_2 = 60°$

$\alpha = 180 - (30 + 60) = 90°$

$\therefore$ **(B), (C) and (D)**

(35,36,37) Key: (D,D,D)

Hint: 35) At 'O' optical path difference is $\Delta x = \left(\mu_g - 1\right)t - \mu_W d\sin\theta$

$$\Delta x \approx 5 \times 10^{-6}\,m \Rightarrow \Delta x = 10\lambda$$

S0, 10^{th} bright fringe will be at 'O'.

36) For central maxima $\Delta x = 0$, where $\Delta x = \frac{yd}{D} + \left(\mu_g - 1\right)t - \mu_W d\sin\theta = 0$

$$y = -\frac{5}{3}cm$$

37) At 'P' we have $\Delta x = \frac{yd}{D} + \left(\mu_g - 1\right)t - \mu_W d\sin\theta$

$$\Delta x = 10\lambda + \frac{3\lambda}{4}$$

Phase diff. $\Delta\phi = 20\pi + \frac{3\pi}{2}$

From $I_R = 4I\cos^2\left(\frac{\Delta\phi}{2}\right)$ we get $I_R = 2I$

$I_{max} = 4I$

At 'P', $\frac{I_R}{I_{max}} = \frac{1}{2}$

Paragraph(38,39)

38. Key:A

In equilibrium: $N_A\lambda_A = N_{B1}\lambda_{B1} \Rightarrow \frac{N_{B1}}{N_A} = \frac{1}{2} = x$. Also, $N_A\lambda_A = N_{B2}\lambda_{B2} \Rightarrow \frac{N_{B2}}{N_A} = \frac{2}{1} = y$

39. Key:D

$\text{For} A : \lambda_A = \lambda_1 + \lambda_2 = 3\lambda$; $N_A = N_0 e^{-3\lambda t}$

40. Key: (5)

Hint: $E_n = -13.6\frac{Z^2}{n^2} = -\frac{54.4}{n^2}eV$

$$\Delta E = 54.4\left(1 - \frac{1}{n^2}\right)eV$$

The total energy of emitted photons, $E_{ph} = \frac{hc}{\lambda_1} + \frac{hc}{\lambda_2} = 52.08eV$

$$54.4\left(1 - \frac{1}{n^2}\right) = 52.08$$

$$\Rightarrow n = 5$$

41. KEY: (5)

Since the cross sectional area of the parts AN and NB are in the ratio 4 : 1, the resistance per unit length will be in the ratio 1 : 4 and therefore the potential gradient in the part NB will be four times that in the part AN i.e. 4V/m. Let CN be x meter and ND be $(0.2 - x)$ meter. The potential difference across

$$CD = 1x + (0.2 - x)4 = 0.5(given).$$

42. KEY: (6)

At steady state energy released per sec

$= \eta \times r\left(E_1 + E_2\right)$

$\eta = 25\%$

$r = 10^{15}$

$E_1 = 100 \times 10^6 \times 1.6 \times 10^{-19} = 1.6 \times 10^{-11}\, J$

$E_2 = 50 \times 10^6 \times 1.6 \times 10^{-19} = 0.8 \times 10^{-11}\, J$

$\mathrm{P} = \left(\mathrm{E}_1 + \mathrm{E}_2\right) \times 10^{15} = 24\mathrm{KW}$

Power generated, $\mathrm{P}_{\text{gen}} = \frac{1}{4} \times 24 = 6\mathrm{KW}$

43. Key: (6)

(Amplitude $\rightarrow$ amplitude/4, so energy $\rightarrow$ energy/16

This is four half lives

so time taken is 8.0 seconds, i.e. 1800 oscillations

44. Key: (6)

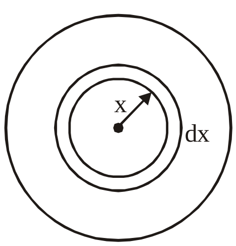
Hint: Energy of a transverse wave in a string $\mathrm{E}\ \alpha\ (\text{amplitude})^2\,(\text{ang.frequency})^2$

$$\frac{\mathrm{E}_2}{\mathrm{E}_1} = \left(\frac{\mathrm{A}}{\mathrm{A}/2}\right)^2 \left(\frac{3\omega}{\omega}\right)^2$$

$\mathrm{E}_2 = 36\mathrm{E}_1$

$\mathrm{E}_2 = \mathrm{n}^2\mathrm{E}_1 \Rightarrow \mathrm{n} = 6$

45: KEY: (2)



$\mathrm{E} = \frac{\mathrm{x}}{2}\frac{\mathrm{dB}}{\mathrm{dt}}$

$$E = \frac{3Kxt^2}{2}$$

$$d\tau = \frac{3Kxt^2}{2} \times \frac{2\pi x dx}{\pi r^2} q.x$$

$$\tau = \frac{3Kt^2 q}{r^2} \int_0^r x^3 dx$$

$$\tau = \frac{3Kq.t^2}{4}.r^2 \qquad \text{...(i)}$$

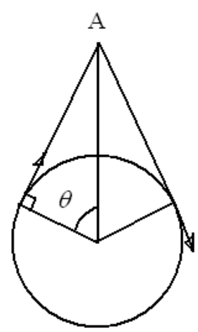
torque due to friction force $d\tau = \mu dmgx$

$$\tau = 2\mu g \frac{qm}{r^2} \int_0^r x^2 dx = \frac{2}{3}\mu mgr \qquad \text{...(ii)}$$

$$\frac{3Kq.t^2 r^2}{4} = \frac{2}{3}\mu mgr$$

$$t = \sqrt{\frac{8\mu mg}{9Kqr}} = 2 \text{ seconds.}$$

46. Key: (4)



Hint: $\cos\theta = \frac{1}{2} \Rightarrow \theta = \frac{\pi}{3}$

$$2\theta = \frac{2\pi}{3}$$

$$\frac{2\pi}{3} = \frac{\omega\pi}{6}$$

$$\omega = 4 \text{rad/s}$$

MATHS

47. $z^3 - 27 = (z-3)(z-3w)(z-3w^2)$

take log on both sides and differentiate w.r.t z.

49. Transverse axis : x + y – 6 = 0

$SS' = 2ae = 6\sqrt{2}$

Conjugate axis : x – y – 4 = 0

also, $b^2 = 8$

50. Substitute cosA and sin A, we get sin (A-B) = $\pm 1/3$

52. In S_n formula replace r by (n-r)

$\Rightarrow S_n = \frac{n}{2} t_n$

$\Rightarrow \text{ans} : 1/2$

53. Obtain the characteristic equation of matrix A, Using $|A - \lambda I_3| = 0$

54. on comparing the coeff. (n-2) (n-3) (n-4)=0

55. d) Transverse axis : x + y – 6 = 0

$SS' = 2ae = 6\sqrt{2}$

Conjugate axis : x – y – 4 = 0

also, $b^2 = 8$

56. d) $t_1^3 t_2 = -1$

57. Put $t = \frac{1}{z}$ and we get $f(x) + \left(\frac{1}{x}\right) = \frac{1}{2}(\ln x)^2$

58. The region is intersection of three regions ,disc of radius 4 with cente at origin, $\sqrt{3}x + y > 0$ and $|x| > |y|$.

59. Distance of point (1,-3) from line x+y=0

60,61,62. Make the figure.

63. $\frac{1}{\sqrt{2}}\int_0^{\pi/6} \sec\left(\frac{x}{2}+\frac{\pi}{4}\right)dx = \sqrt{2}\ln\left(\sqrt{8}+\sqrt{6}-\sqrt{4}-\sqrt{3}\right)$

64. Convert limits of integrals from (0 to 1)

65. Apply $\Delta > 0$

66. Write the value of $\cot^{-1}(\cot \pi x)$ in $(0,8)$ and split the integral into intervals

69. Let $\overrightarrow{AD}$ be the median, $\overrightarrow{AD} = \frac{\overrightarrow{AB}+\overrightarrow{AC}}{2}$. Now apply the condition that the median through A is equally inclined to the positive directions of the axes