Sri Chaitanya

IIT Academy., India

JEE - MAIN 2018

Question Paper

Solutions

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www.srichaitanya.net

PAPER-1

CHEMISTRY , MATHEMATICS & PHYSICS

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

Important Instructions

1. Immediately fill in the particulars on this page of the Test Booklet with only **Black ball Point Pen** provided in the examination hall.
2. The Answer Sheet is kept inside this Test Booklet. When you are directed to open the Test Booklet, take out the Answer Sheet and fill in the particulars carefully.
3. The test is of **3 hours** duration.
4. The Test Booklet consists of 90 questions. The maximum marks are **360**.
5. There are **three** parts in the question paper A, B & C consisting of **Chemistry, Mathematics** and **Physics** having 30 questions in each part of equal weightage. Each question is allotted **4 (four)** marks for each correct response.
6. *Candidates will be awarded marks as stated above in instruction No.5 for correct response of each question. ¼ (one fourth) marks allotted to the question (i.e 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.*
7. 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 instructions 6 above
8. For writing Particulars/marking responses on **side-1** and **side-2** of the Answer sheet use **only Black Ball point Pen** provided in the examination hall.
9. No candidate is allowed to carry any textual material, printed or written, bits of papers pager, mobile phone, any electronic device, etc except the Admit Card inside the examination room/hall.
10. Rough work is to be done on the space provided for this purpose in the Test Booklet only. This space is given at the bottom of each page and in **four** pages (pages **20-23**) at the end of the booklet.
11. On completion of the test, the candidate must hand over the Answer Sheet to the Invigilator on duty in the Room/Hall. ***However, the candidates are allowed to take away this Test Booklet with them***.
12. The CODE for this Booklet is **C**. Make sure that the CODE printed on **Side-2** of the Answer sheet is same as that on this Booklet. Also tally the serial numbers of the Test Booklet and Answer Sheet are the same as that on this booklet. In case of discrepancy, the candidate should immediately report the matter to the Invigilator for replacement of both the Test Booklet and the Answer Sheet.
13. **Do not fold or make any stray mark on the Answer Sheet.**

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CHEMISTRY

01. **Which of the following salts is the most basic in aqueous solution?**

1) CH_3COOK

2) $FeCl_3$

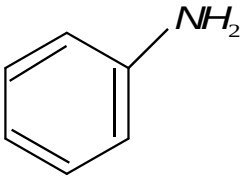
3) $Pb(CH_3COO)_2$

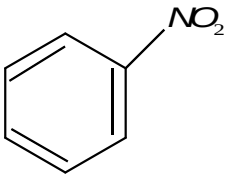
4) $Al(CN)_3$

Key: **1**

Sol: **Only one anion** $\left(CH_3COO^-\right)$ **undergoing hydrolysis. Where as in other salts** $Pb\left(CH_3COO\right)_2$ **and** $Al\left(CN\right)_3$**, cation is also undergoing hydrolysis.**

02. **Which of the following compounds will be suitable for Kjeldahl's method for nitrogen estimaton?**

1) 

2) 

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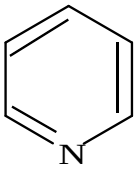
4) 

Key: **1**

Sol: **Pyridine, diazonium salts, nitro compounds will not give kjeldahl's method.**

03. **Which of the following are Lewis acids?**

1) $AlCl_3 \text{ and } SiCl_4$

2) $PH_3 \text{ and } SiCl_4$

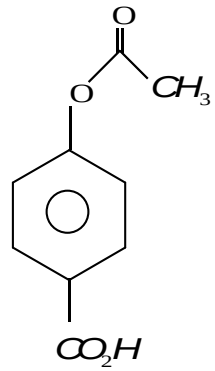
3) $BCl_3 \text{ and } AlCl_3$

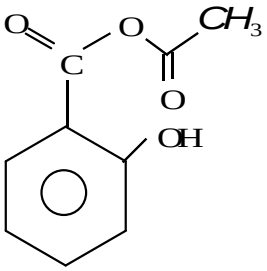
4) $PH_3 \text{ and } BCl_3$

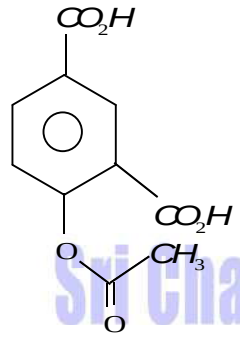
Key: **3**

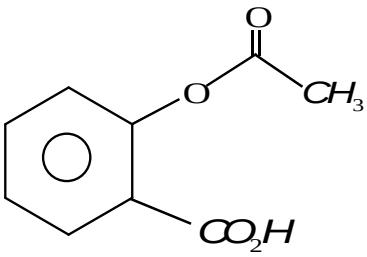
Sol: **Both** BCl_3 **and** $AlCl_3$ **are electron difficient molecule.**

04. **Phenol on treatment with CO_2 in the presence of NaOH followed by acidification produces compound X as the major product. X on treatment with $(CH_3CO)_2O$ in the presence of catalytic amount of H_2SO_4 produces:**

1) 

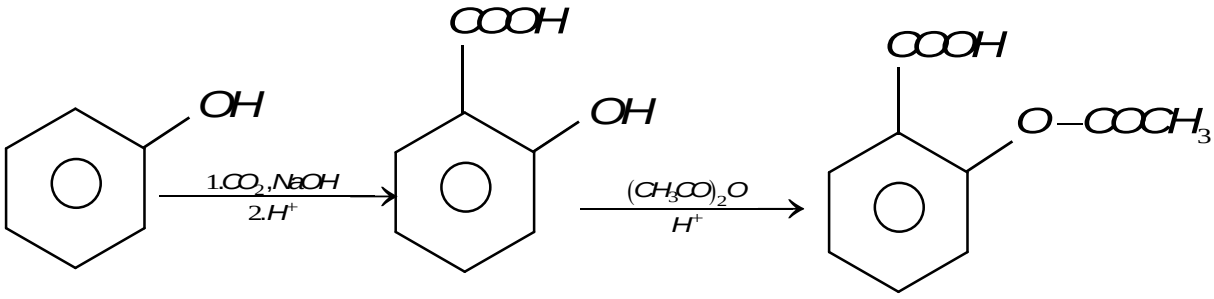
2) 

3) 

4) 

Key: **4**

Sol:



05. **An alkali is titrated against an acid with methyl orange as indicator, which of the following is a correct combination?**

	Base	Acid	End point
1)	**Strong**	**Strong**	**Pinkish red to yellow**
2)	**Weak**	**Strong**	**Yellow to pinkish red**
3)	**Strong**	**Strong**	**Pink to colourless**
4)	**Weak**	**Strong**	**Colourless to pink**

Key: **2**

Sol: **In basic medium, methyl orange shows yellow colour and in acidic medium shows pinkish red colour.**

06. **An aqueous solution contains 0.10 M H_2S and 0.20 M HCl. If the equilibrium constants for the formation of HS^- from H_2S is 1.0×10^{-7} and that of S^{2-} from HS^- ions is 1.2×10^{-13} then the concentration of S^{2-} ions in aqueous solution is :**

1) 3×10^{-20}

2) 6×10^{-21}

3) 5×10^{-19}

4) 5×10^{-8}

Key: **1**

Sol:

$$H_2S \rightleftharpoons H^+ + HS^-$$
$$HS^- \rightleftharpoons H^+ + S^{2-}$$
$$\overline{H_2S \rightleftharpoons 2H^+ + S^{2-}}$$

$$K = K_1K_2 = \frac{[H^+]^2[S^{2-}]}{[H_2S]}$$

$$[S^{2-}] = \frac{1\times10^{-7}\times1.2\times10^{-13}\times0.1}{[0.2]^2}$$

$$= 3\times10^{-20}$$

07. **The combustion of benzene (I) gives CO_2 (g) and H_2O (I). Given that heat of combustion of benzene at constant volume is -3263.9 kJ mol^{-1} at 25^0 C; heat of combustion (in kJ mol^{-1}) of benzene at constant pressure will be: $\left(R = 8.314\,JK^{-1}mol^{-1}\right)$**

1) -452.46

2) 3260

3) -3267.6

4) 4152.6

Key: 3

Sol: $C_6H_6(l)+7.5O_2(g)\rightarrow 6CO_2(g)+3H_2O(l)$

$\Delta H=6-7.5=-1.5$

$\Delta H=\Delta U+\Delta nRT$

$=-3263.9+(-1.5)(8.314\times10^{-3})(298)$

$=-3267.6\,kJ\,mol^{-1}$.

08. **The compound that does not produce nitrogen gas by the thermal decomposition is:**

1) $(NH_4)_2Cr_2O_7$

2) NH_4NO_2

3) $(NH_4)_2SO_4$

4) $Ba(N_3)_2$

Key: 3

Sol: $(NH_4)_2Cr_2O_7\xrightarrow{\Delta}N_2+Cr_2O_3+4H_2O$

$NH_4NO_2\xrightarrow{\Delta}N_2+2H_2O$

$(NH_4)_2SO_4\xrightarrow{\Delta}NH_3+NH_4HSO_4$

$Ba(N_3)_2\xrightarrow{\Delta}3N_2+Ba$

09. **How long(approximate) should water be electrolysed by passing through 100 amperes current so that the oxygen released can completely burn 27.66 g of diborane? (Atomic weight of B=10.8 u)**

1) 0.8 hours

2) 3.2 hours

3) 1.6 hours

4) 6.4 hours

Key: 2

Sol: $B_2H_6(g)+3O_2\rightarrow B_2O_3+3H_2O$

$27.66\,g \quad 3(32)\,g$

From Faraday's first law

Mass of gas liberated (m) $=\dfrac{E.c.t}{96500}$

$3(32)=\dfrac{8\times100\times t}{96500}$

t in hours $=\dfrac{96\times96500}{8\times100\times60\times60}=3.21\,hrs$

10. **Total number of lone pair of electrons in I_3^- ion is :**

1) 6

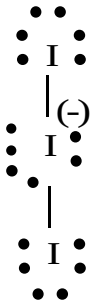
2) 9

3) 12

4) 3

Key: **2**

Sol:



$\therefore$ 9 lone pair of electrons.

11. **When metal 'M' is treated with $NaOH$, a white gelatinous precipitate 'X' is obtained, which is soluble in excess of NaOH. Compound 'X' when heated strongly gives an oxide which is used in chromatography as an adsorbent. The metal 'M' is :**

1) Ca

2) Al

3) Fe

4) Zn.

Key: **2**

Sol: **Oxide which is used as adsorbent in chromatography is Al_2O_3.**

$$Al + NaOH \rightarrow Al(OH)_3 \downarrow + 3Na^+$$

gelatinous

white ppt

$$Al(OH)_3 + NaOH \rightarrow Na\left[Al(OH)_4(H_2O)_2\right]$$

soluble

12. **According to molecular orbital theory, which of the following will not be a viable molecule?**

1) He_2^+

2) H_2^-

3) H_2^{2-}

4) He_2^{2+}.

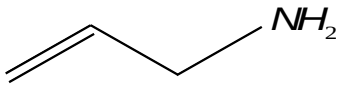
Key: 3

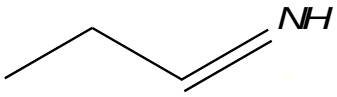
Sol:

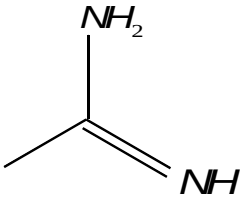
ion	Bond order
He_2^+	0.5
H_2^-	0.5
H_2^{2-}	0
He_2^{2+}	1.

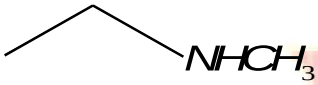
Therefore H_2^{2-} will not exist.

13. The increasing order of basicity of the following compounds is:

a) 

b) 

c) 

d) 

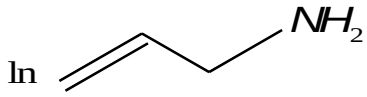
1) $(b)<(a)<(c)<(d)$

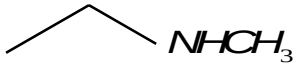
2) $(b)<(a)<(d)<(c)$

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

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

Key: 2

Sol: In  **, negative inductive effect is present.**

Where as  **is secondary amine.**

14. Which type of 'defect' has the presence of cations in the interstitial sites?

1) Vacancy defect

2) Frenkel defect

3) Metal deficiency defect

4) Schottky defect

Key: 2

Sol: **In Frenkel defect, metal cation occupies interstitial site.**

15. **Which of the following compounds contain(s) no covalent bond (s)**

$KCl, PH_3, O_2, B_2H_6, H_2SO_4$

1) KCl, H_2SO_4

2) KCl

3) KCl, B_2H_6

4) KCl, B_2H_6, PH_3.

Key: **2**

Sol: KCl **is a ionic compound.**

16. **The oxidation states of Cr in** $\left[Cr\left(H_2O\right)_6\right]Cl_3, \left[Cr\left(C_6H_6\right)_2\right]$, **and** $K_2\left[Cr\left(CN\right)_2\left(O\right)_2\left(O\right)_2\left(NH_3\right)\right]$ **respectively are :**

1) $+3, +2,$ *and* $+4$

2) $+3, 0,$ *and* $+6$

3) $+3, 0,$ *and* $+4$

4) $+3, +4,$ *and* $+6$.

Key: **2**

Sol:

Compound	**O.s of Cr**
$\left[Cr\left(H_2O\right)_6\right]Cl_3$	**+3**
$\left[Cr\left(C_6H_6\right)_2\right]$	**0**
$K_2\left[Cr\left(CN\right)_2\left(O_2\right)\left(O_2\right)\left(NH_3\right)\right]$	**+6**

17. **Hydrogen peroxide oxidises** $\left[Fe\left(CN\right)_6\right]^{4-}$ **to** $\left[Fe\left(CN\right)_6\right]^{3-}$ **in acidic medium but reduces** $\left[Fe\left(CN\right)_6\right]^{3-}$ **to** $\left[Fe\left(CN\right)_6\right]^{4-}$ **in alkaline medium. The other products formed are, respectively.**

1) $\left(H_2O + O_2\right)$ *and* $\left(H_2O + OH^-\right)$

2) H_2O *and* $\left(H_2O + O_2\right)$

3) H_2O *and* $\left(H_2O + OH^-\right)$

4) $\left(H_2O + O_2\right)$ *and* H_2O.

Key: **2**

Sol: $2\left[Fe\left(CN_6\right)\right]^{4-} + H_2O_2 + 2H^+ \rightarrow 2\left[Fe\left(CN\right)_6\right]^{3-} + 2H_2O$

$2\left[Fe\left(CN_6\right)\right]^{3-} + H_2O_2 + 2OH^- \rightarrow 2\left[Fe\left(CN\right)_6\right]^{4-} + 2H_2O + O_2$

18. **Glucose on prolonged heating with HI gives :**

1) 1-Hexene

2) Hexanoic acid

3) 6-iodohexanal

4) n-Hexane.

Key: **4**

Sol:

$$C_6H_{12}O_6 \xrightarrow[\Delta]{HI} \underset{\underset{I}{|}}{CH_3CH}(CH_2)_3CH_3 + CH_3(CH_2)_4CH_3$$

$\alpha-Iodohexane$ $\quad$ $n-hexane$

19. **The predominant form of histamine present in human blood is** $\left(pK_a, Histidine = 6.0\right)$

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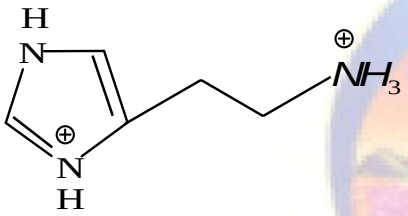
1)



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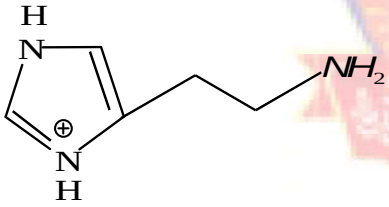

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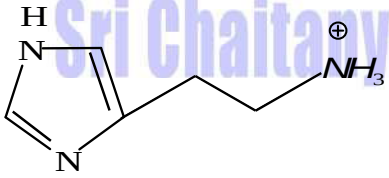

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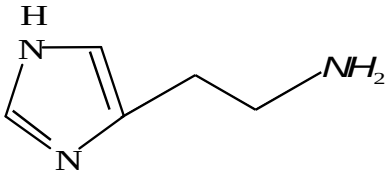
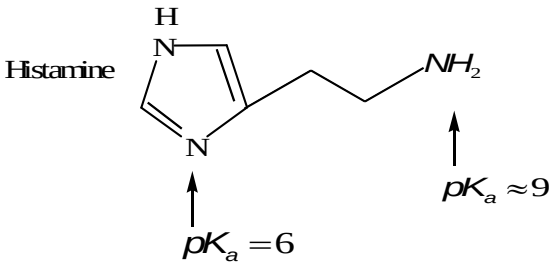
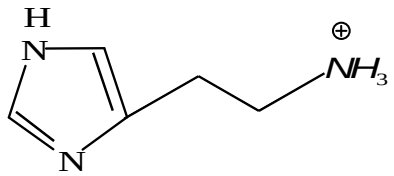


Key: **3**

Sol:



In blood (PH ≈ 7.2). histamine become



20. **The recommended concentration of fluoride ion in drinking water is up to 1 ppm as fluoride ion is required to make teeth enamel harder by converting $\left[3Ca_3\left(PO_4\right)_2.Ca\left(OH_2\right)\right]$ to :**

1) $\left[3\left(CaF_2\right).Ca\left(OH\right)_2\right]$

2) $\left[3Ca_3\left(PO_4\right)_2.CaF_2\right]$

3) $\left[3\left\{Ca\left(OH\right)_2\right\}.CaF_2\right]$

4) $\left[CaF_2\right]$.

Key: **2**

Sol: **When** F^- **ion react with teeth enamel,** $\left[3Ca_3\left(PO_4\right)_2.Ca\left(OH_2\right)\right]$ **changes as fluorapatite** $\left[3Ca_3\left(PO_4\right)_2.CaF_2\right]$.

21. **Consider the following reaction and statements :**

$$\left[Co\left(NH_3\right)_4Br_2\right]^+ + Br^- \rightarrow \left[Co\left(NH_3\right)_3Br_3\right] + NH_3$$

(I) **Two isomers are produced if the reactant complex ion is a cis-isomer.**

(II) **Two isomers are produced if the reactant complex ion is a trans-isomer.**

(III) **Only one isomer is produced if the reactant complex ion is a trans-isomer.**

(IV) **Only one isomer is produced if the reactant complex ion is a cis-isomer.**

The correct statements are :

1) $\left(I\right)$ *and* $\left(III\right)$

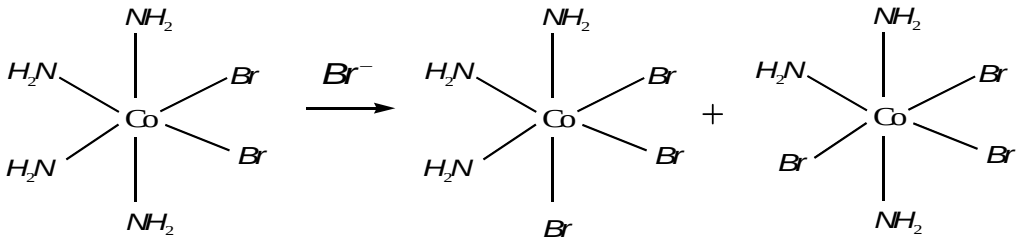
2) $\left(III\right)$ *and* $\left(IV\right)$

3) $\left(II\right)$ *and* $\left(IV\right)$

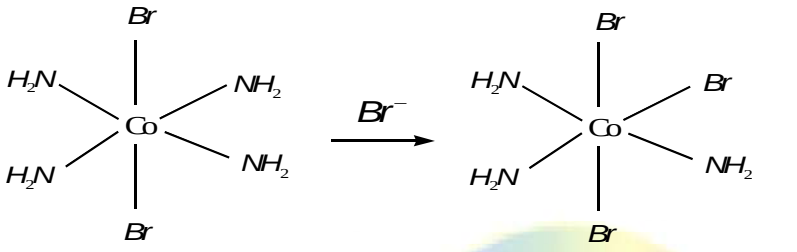
4) $\left(I\right)$ *and* $\left(II\right)$.

Key: **1**

Sol: **When** $\left[Co\left(NH_3\right)_4Br_2\right]^+$ **is cis-isomer**



cis-isomer fac-isomer mer-isomer



trans-isomer fac-isomer only formed

22. **The trans-alkanes are formed by the reduction of alkynes with :**

1) $NaBH_4$

2) $Na/liq.NH_3$

3) $Sn-HCl$

4) $H_2-Pd/C, BaSO_4$.

Key: **2**

Sol: **Alkyne** $\xrightarrow{Na/liq.NH_3}$ **trans-alkene.**

23. **The ratio of mass percent of C and H of an organic compound** $(C_XH_YO_Z)$ **is 6 : 1. If one molecule of the above compound** $(C_XH_YO_Z)$ **contains half as much oxygen as required to burn one molecule of compound** C_XH_Y **completely to** CO_2 **and** H_2O**. The empirical formula of compound** $C_XH_YO_Z$ **is :**

1) C_2H_4O

2) $C_3H_4O_2$

3) $C_2H_4O_3$

4) $C_3H_6O_3$.

Key: **3**

Sol: **On combustion of** C_XH_Y **having 6 : 1 ratio of C and H will be**

$$C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$$

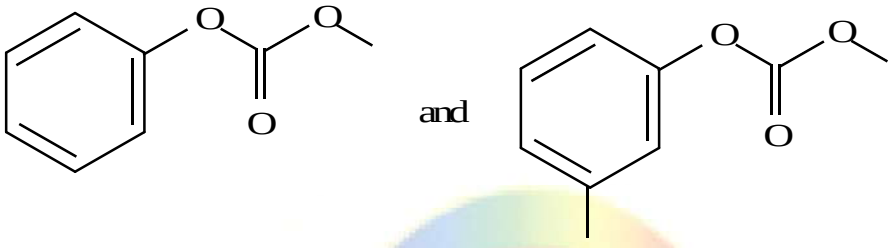
$$(6\ atoms\ of\ oxygen)$$

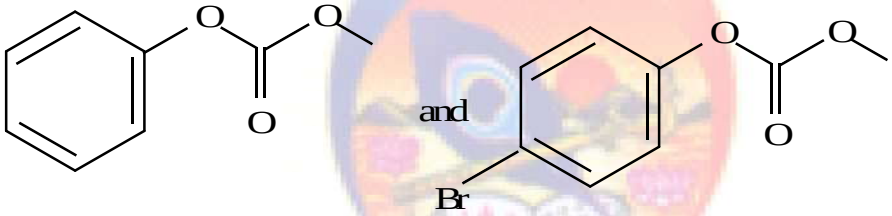
$$C_3H_6 + \frac{9}{2}O_2 \rightarrow 3CO_2 + 3H_2O$$

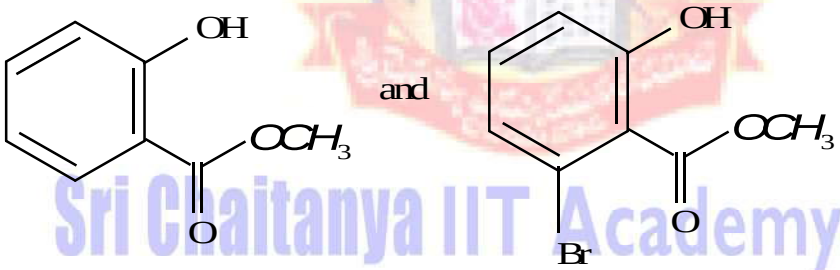
$$(9\ atoms\ oxygen)$$

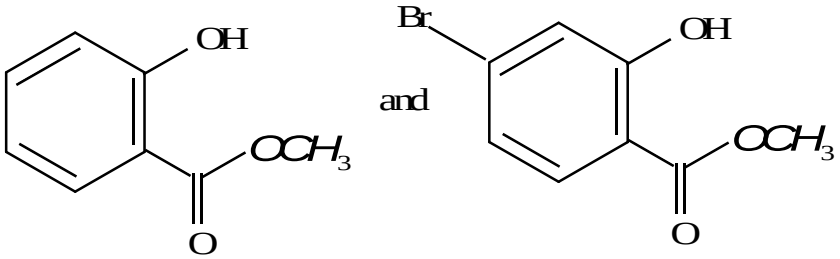
$\therefore C_XH_YO_2$ **will be** $C_2H_4O_3$.

24. **Phenol reacts with methyl chloroformate in the presence of NaOH to form product A. A reacts with Br_2 to form product B. A and B are respectively.**

1) 

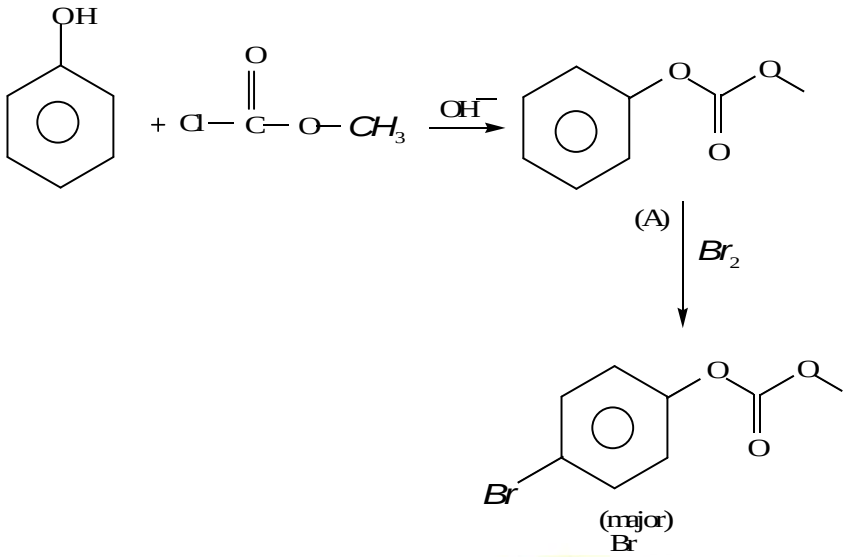
2) 

3) 

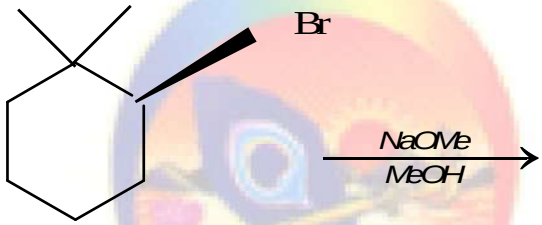
4) 

Key: 2

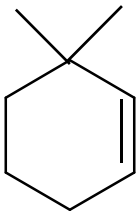
Sol:



25. **The major product of the following reaction is:**

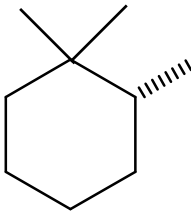


1)

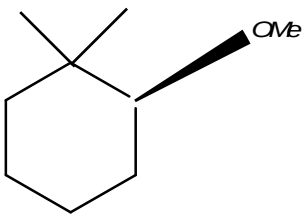


2)

3)

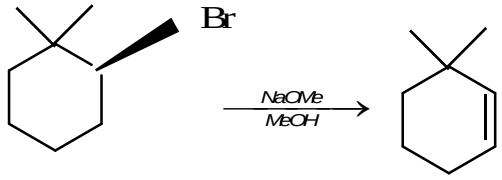


4)

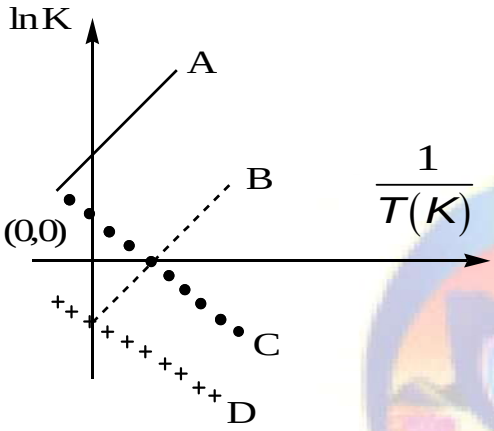


Key: **1**

Sol: With strong base and bulky groups at $\beta-$ carbon leads elimination rather than SN^2 substitution



26. Which of the following lines correctly show the temperature dependence of equilibrium constant, K, for an exothermic reaction?



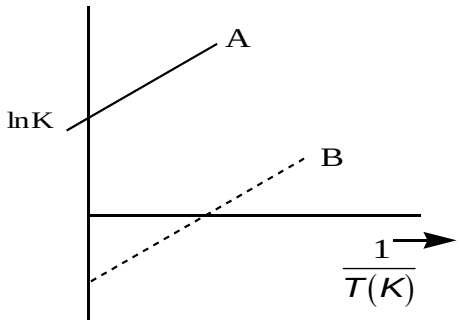
1) B and C
2) C and D
3) A and D
4) A and B.

Key: 4

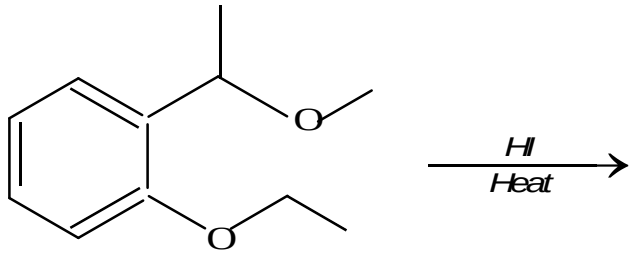
Sol: $4\ln kc = \ln A - \frac{\Delta H}{2.303R}\left(\frac{1}{T}\right)$

Here $\Delta H = -ve.(exothermic\ reaction)$

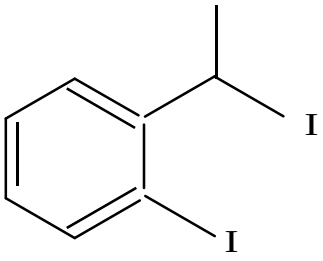
$\therefore$ graph will be



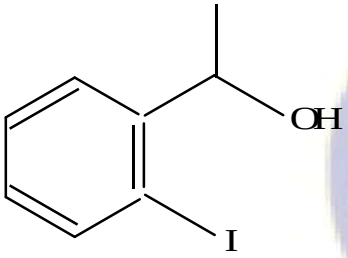
27. **The major product formed in the following reaction is:**



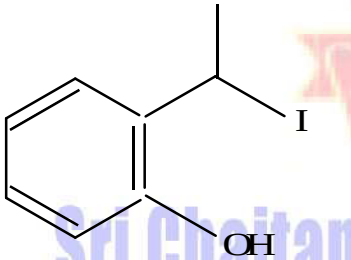
1)



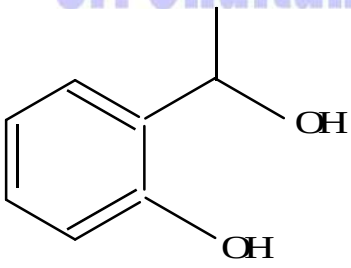
2)



3)

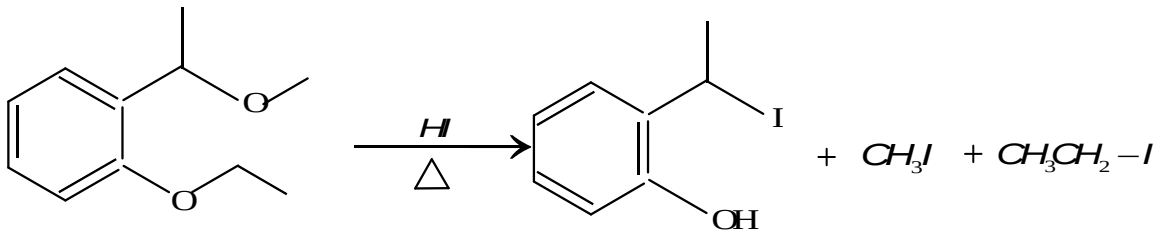


4)



Key: **3**

Sol:



28. **An aqueous solution contains an unknown concentration of Ba^{2+}. When 50 mL of a 1 M solution of Na_2SO_4 is added, $BaSO_4$ just begins to precipitate. The final volume is 500 mL. The solubility product of $BaSO_4$ is 1×10^{-10}. What is the original concentration of Ba^{2+} ?**

1) $2\times10^{-9}M$

2) $1.1\times10^{-9}M$

3) $1.0\times10^{-10}M$

4) $5\times10^{-9}M$.

Key: **2**

Sol: **After addition of 50 mL 1 M Na_2SO_4 to the solution having Ba^{2+} ion become 500 mL**

$$\therefore new\left[SO_4^{2-}\right]=\frac{50\times1}{500}=0.1M\text{ .}$$

$$\therefore In\ 500mL,\left[Ba^{2+}\right]=\frac{K_{sp}\left(BaSO_4\right)}{\left[SO_4^{2-}\right]}=\frac{1\times10^{-10}}{0.1}$$

$$=1\times10^{-9}M$$

Now, in 450 mL of initial solution , $\left[Ba^{2+}\right]=\frac{1\times10^{-9}\times500}{450}=1.1\times10^{-9}M$.

29. **At 518^0C, the rate of decomposition of a sample of gaseous acetaldehyde, initially at a pressure of 363 Torr, was 1.00 Torr s^{-1} when 5% had reacted and 0.5 Torr s^{-1} when 33% had reacted. The order of the reaction is :**

1) 3

2) 1

3) 0

4) 2

Key: **4**

Sol: $\frac{r_1}{r_2}=\left(\frac{P_1}{P_2}\right)^n$

$$\log\frac{r_1}{r_2} = n\log\left(\frac{P_1}{P_2}\right)$$

Order of the reaction (n) = $\dfrac{\log\frac{r_1}{r_2}}{\log\frac{P_1}{P_2}}$

$$= \frac{\log\frac{1}{0.5}}{\log\left(\frac{344.8}{243.2}\right)} = \frac{0.3}{0.15} = 2.$$

30. **For 1 molal aqueous solution of the following compounds, which one will show the highest freezing point?**

1) $\left[Co\left(H_2O\right)_5 Cl\right]Cl_2.H_2O$

2) $\left[Co\left(H_2O\right)_4 Cl_2\right]Cl.2H_2O$

3) $\left[Co\left(H_2O\right)_3 Cl_3\right].3H_2O$

4) $\left[Co\left(H_2O\right)_6\right]Cl_3.$

Key: **3**

Sol: **Freezing point will be highest, when solute is not undergoing any dissociation**

$\therefore\left[Co\left(H_2O\right)Cl_3\right].3H_2O.$

MATHEMATICS

31. **The integral**

$$\int \frac{\sin^2 x \cos^2 x}{\left(\sin^5 x + \cos^3 x \sin^2 x + \sin^3 x \cos^2 x + \cos^2 x\right)} dx$$

is equal to

1) $\frac{-1}{3\left(1+\tan^3 x\right)} + C$

2) $\frac{1}{1+\cot^3 x} + C$

3) $\frac{-1}{1+\cot^3 x} + C$

4) $\frac{1}{3\left(1+\tan^3 x\right)} + C$

(Where C is a constant of integration)

Key: **1**

Sol: **Let** $\tan x = t$

$$= \int \frac{t^2.\left(\sec^6 x\right)}{\left(t^5+t^2+t^3+1\right)^2} dt$$

$$= \int \frac{t^2\left(1+t^2\right)}{\left(t^3+1\right)^2\left(t^2+1\right)^2} dt$$

$$= \int \frac{t^2\left(1+t^2\right)}{\left(1+t^3\right)^2} dt$$

Let $\frac{1}{1+t^3} = p$; $= \frac{-1}{3}\int \frac{-3t^2\left(1+t^2\right)}{\left(1+t^3\right)^2} dt$

$$= \frac{-1}{3}\int dp = \frac{-1}{3}\frac{1}{1+\tan^3 x} + C$$

32. **Tangents are drawn to the hyperbola $4x^2 - y^2 = 36$ at the points P and Q. If these tangents intersect at the point $T(0,3)$ then the area (in sq. units) of ΔPTQ is**

1) $54\sqrt{3}$

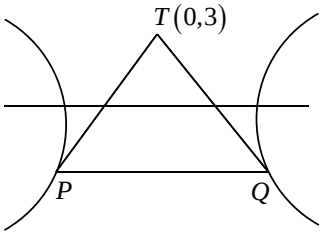
2) $60\sqrt{3}$

3) $36\sqrt{3}$

4) $45\sqrt{5}$

Key: **4**

Sol: $\frac{x^2}{9} - \frac{y^2}{36} = 1$ **is help**



Eq of $CC\ AB$ **is** $\frac{-y3}{36} - 1 = 0\ \ y = -12$

$\Rightarrow P, Q$ **are** $\left(\pm\sqrt{45}, -12\right)$

$\therefore$ **area of** $TPQ = \frac{1}{2}(15).2\sqrt{45}$

$45\sqrt{5}$

33. **Tangent and normal are drawn at $P(16,16)$ on the parabola $y^2 = 16x$, which intersect the axis of the parabola at A and B, respectively. If C is the centre of the circle through the points P, A and B and $\angle CPB = \theta$, then a value of $\tan\theta$ is:**

1) 2

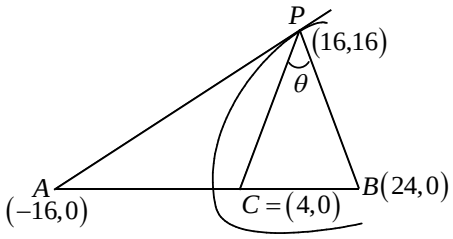
2) 3

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

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

Key: **1**

Sol: $y^2 = 16x$



$\therefore \tan\theta = 2$ **(using slopes).**

34. **Let $\vec{u}$ be a vector coplanar with the vectors $\vec{a} = 2\hat{j} + 3\hat{j} - \hat{k}$ and $\vec{b} = \hat{j} + \hat{k}$. If $\vec{u}$ is perpendicular to $\vec{a}$ and $\vec{u}.\vec{b} = 24$ and $|\vec{u}|^2$ is equal to:**

1) 315

2) 256

3) 84

4) 336

Key: **4**

Sol: $u = ka \times (a \times b)$

$\Rightarrow \bar{u} = k(a.b)\bar{a} - |a|^2 \bar{b}$

$u.b = k\left((a-b)^2 - a^2b^2\right) = 24$

$\Rightarrow k(4-28) = 24$

$k = -1$

$u = -a \times (a \times b)$

$= -2\bar{a} + 14\bar{b}$

$u^2 = 336$

35. **If $\alpha, \beta \in C$ are the distinct roots, of the equation $x^2 - x + 1 = 0$, then $\alpha^{101} + \beta^{107}$ is equal to:**

1) 0

2) 1

3) 2

4) -1

Key: 2

Sol: $x^2-x+1=0$

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

Root are $-w$ & $-w^2$

$\alpha=-w,\beta=-w^2$

$\alpha^{101}+\beta^{107}$

$\alpha^{99}.\alpha^2+\beta^{105}.\beta^2$

$=-(\alpha^2+\beta^2)=-(1-2)=1$

36. **Let** $g(x)=\cos x^2$, $f(x)=\sqrt{x}$, $\alpha,\beta(\alpha<\beta)$ **be the roots of the quadratic equation** $18x^2-9\pi x+\pi^2=0$. **Then the area (in sq. units) bounded by the curve** $y=(gof)(x)$ **and the lines** $x=\alpha, x=\beta$ **and** $y=0$, **is:**

1) $\frac{1}{2}(\sqrt{3}+1)$

2) $\frac{1}{2}(\sqrt{3}-\sqrt{2})$

3) $\frac{1}{2}(\sqrt{2}-1)$

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

Key: 4

Sol: $gof(x)$

$=g(\sqrt{x})$

$=\cos x$

$\therefore$ **area** $=\int_{\frac{\pi}{6}}^{\frac{\pi}{3}}\cos x\,dx=\left|-\sin x\right|_{\frac{\pi}{6}}^{\frac{\pi}{3}}$

$=\frac{\sqrt{3}-1}{2}$

37. **The sum of the co-efficients of all odd degree terms in the expansion of** $\left(x+\sqrt{x^3-1}\right)^5+\left(x-\sqrt{x^3-1}\right)^5, (x>1)$ **is:**

1) 0

2) 1

3) 2

4) -1

Key: **3**

Sol: $5C_0x^5+5C_0x^4\sqrt{x^3-1}+5C_2x^3\left(x^3-1\right)-5C_3x^2$

$$2\left[5C_0x^5+5C_2x^3\left(\sqrt{x^3-1}\right)^2+5C_4x\left(\sqrt{x^3-1}\right)^4\right]$$

$$2\left[5C_0x^5+5C_2x^3\left(x^3-1\right)+5C_4x\left(x^3-1\right)^2\right]$$

$$2\left[5C_0x^5+5C_2x^6-5C_2x^3+5C_4x\left(x^6-2x^3+1\right)\right]$$

$$2\left[5C_0x^5+5C_2x^6-5C_2x^3+5C_4x^7-2\times5C_4x^4+5C_4x\right]$$

$$2\left[5C_0-5C_2+5C_4+5C_4\right]$$

$$2\left[1-10+5+5\right]=2$$

38. **Let** $a_1,a_2,a_3,\ldots,a_{49}$ **be in A.P. Such that** $\sum_{k=0}^{12}a_{4k+1}=416$ **and** $a_9+a_{43}=66$**. If**

$a_1^2+a_2^2+\ldots.+a_{17}^2=140$ **m, then m is equal to:**

1) 68

2) 34

3) 33

4) 66

Key: **2**

Sol: $a_1+a_5\ldots+a_{49}=416$

$a_9+a_{43}=66$

$a_1+\left(a_1+4d\right)+\left(a_1+8d\right)+\left(a_1+12d\right).\left(a_1+48d\right)=416$

$13a_1 + 4d(1+2+3-12) = 416$

$13a_1 + 312d = 416$

$a_1 + 24d = 32$ **…. (1)**

$a_1 + 8d + a_1 + 42d = 66$

$2a_1 + 50d = 66$

$a_1 + 25d = 33$ **….(2)**

$d = 1$

$a_1 = 8$

$a_1^2 + a_2^2 - .. + a_{17}{}^2$

$8^2 + 9^2 + 10^2 ... + 24^2$

$\Rightarrow \frac{24\times 25\times 44}{6} - \frac{7\times 8\times 15}{6}$

$25\times 4\times 49 - 7\times 4\times 5$

$5\times 4\times 7[5\times 7 - 1]$

$20\times 7\times 34 = 140m$

$\Rightarrow m = 34$

39. **If** $\sum_{i=1}^{9}(x_i - 5) = 9$ **and** $\sum_{i=1}^{9}(x_i - 5)^2 = 45$**, then the standard deviation of the 9 items** $x_1, x_2, ..., x_9$ **is:**

1) 4

2) 2

3) 3

4) 9

Key: **2**

Sol: $\sum_{i=1}^{9}(x_i - 5) = 9 \qquad \bar{x} = \frac{\Sigma xi}{9} = 6$

$\frac{1}{9}\sum(x_i - \bar{x})^2$

$$\frac{1}{9}\sum\left(x_i-5-6+5\right)^2$$

$$\frac{1}{9}\sum\left(x_i-5-1\right)^2$$

$$\frac{1}{9}\sum_{i=1}^{9}\left(x_i-5\right)^2-\frac{2}{9}\sum\left(x_i-5\right)+\frac{9}{4}=$$

$$\frac{1}{9}45-2/9\times9+1=4$$

$$S.D=2.$$

40. **PQR is a triangular park with PQ = PR = 200 m. A T.V. tower stands at the mid-point of QR. If the angles of elevation of the top of the tower at P,Q and R are respectively $45°,30°$ and $30°$, then the height of the tower (in m) is:**

1) 50

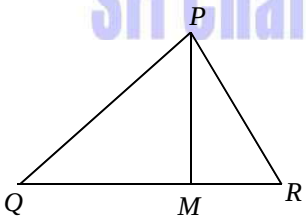
2) $100\sqrt{3}$

3) $50\sqrt{2}$

4) 100

Key: **4**

Sol:



$$PM=h$$

$$\tan 30=\frac{h}{QM}=\frac{h}{KM}$$

$$\sqrt{3}h=QM=RM$$

$$QM^2+PM^2=200^2$$

$$4h^2=40000$$

$$h=1000$$

41. **Two sets A and B are as under:**

$A=\{(a,b)\in R\times R:|a-5|<1 \text{ and } |b-5|<1\}$;

$B=\{(a,b)\in R\times R:4(a-6)^2+9(b-5)^2\le 36\}$, **Then:**

1) $A\subset B$

2) $A\cap B=\phi$ **(an empty set)**

3) neither $A\subset B$ **nor** $B\subset A$

4) $B\subset A$

Key: **1**

Sol: $4(a-6)^2+9(b-5)^2\le 36$

$$\frac{(a-6)^2}{9}+\frac{(b-5)^2}{4}\le 1$$

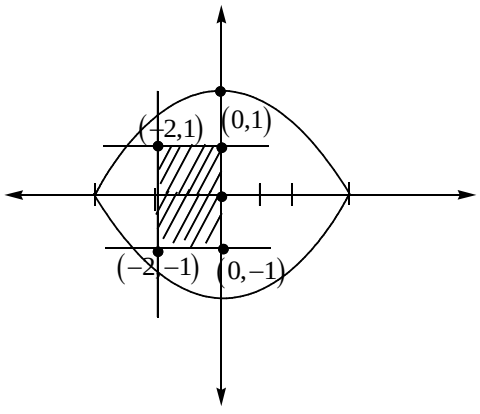
Let origin be shifted to $(6,5)$ **(i.e. Let** $a-6=x, b-5=y$**)**

$$\frac{x^2}{9}+\frac{y^2}{4}\le 1.....(1)$$

$|a-5|<1, |b-5|<1$ $\quad$ $|x+6-5|<1, |y+5-5|<1$

$|x+1|<1$ $|y|<1$

$-1<x+1<1$ $-1<y<1$ $\quad$ $-2<x<0, -1<y<1$



$$(-2,1),(1)\Rightarrow \frac{4}{9}+\frac{1}{4}=\frac{16+9}{36}=\frac{25}{36}<1$$

Similarly $(-2,-1)\Rightarrow(1)\Rightarrow \frac{25}{31}<1 \quad \therefore A<B$

42. **From 6 different novels and 3 different dictionaries, 4 novels and 1 dictionary are to be selected and arranged in a row on a shelf so that the dictionary is always in the middle. The number of such arrangements is:**

1) less than 500

2) at least 500 but less than 750

3) at least 750 but less than 1000

4) at least 1000

Key: **4**

Sol: **The number of arrangements**

$= 6C_4.3C_1.\underline{|4} = 1080$

43. **Let** $f(x) = x^2 + \frac{1}{x^2}$ **and** $g(x) = x - \frac{1}{x}, x \in R - (-1,0,1)$. **If** $h(x) = \frac{f(x)}{g(x)}$, **then the local minimum value of** $h(x)$ **is:**

1) -3

2) $-2\sqrt{2}$

3) $2\sqrt{2}$

4) 3

Key: **3**

Sol: $h(x) = \frac{f(x)}{g(x)} = \frac{g^2(x)+2}{g(x)}$

$h(x) = \left(x - \frac{1}{x}\right) + \frac{2}{x - \frac{1}{x}}$

$h(x)$ **has local mixing** $x - \frac{1}{x} > 0$

$\therefore AM \geq GM$

$$x - \frac{1}{x} + \frac{2}{x - \frac{1}{x}} \geq 2\sqrt{\left(x - \frac{1}{x}\right).\frac{2}{\left(x - \frac{1}{x}\right)}}$$

$h(x) \geq 2\sqrt{2}$

44. **For each $t \in R$, lest$[t]$be the greatest integer less than or equal to t, Then**

$$\lim_{x\to 0+} x\left(\left[\frac{1}{x}\right]+\left[\frac{2}{x}\right]+....+\left[\frac{15}{x}\right]\right)$$

1) is equal to 15

2) is equal to 120

3) does not exist (in R)

4) is equal to 0.

Key: **2**

Sol: $\frac{1}{2}-1 < \left[\frac{1}{x}\right] \le \frac{1}{x}$

$\frac{2}{2}-1 < \left[\frac{2}{x}\right] \le \frac{2}{x}$

$\frac{15}{x}-1 < \left[\frac{15}{x}\right] \le \frac{15}{x}$

Add: $\frac{(1-x)+(2-x)+....+(15-x)}{x} < \left[\frac{1}{x}\right]+\left[\frac{2}{x}\right]+...+\left[\frac{15}{x}\right] \le \frac{1+2+15}{x}$

$$\varepsilon 15-15x < x\left(\left[\frac{1}{x}\right]+\left[\frac{2}{x}\right]+...+\left[\frac{15}{x}\right]\right) \le \varepsilon 15$$

$$\underset{x\to 0+}{Lt}\left(\varepsilon 15-15x\right) < \underset{x\to 0+}{Lt}\left(\left[\frac{1}{x}\right]+\left[\frac{2}{x}\right]+....\left[\frac{15}{x}\right]\right) \le \underset{x\to 0+}{Lt}\ \varepsilon 15$$

$$\varepsilon 15 < \underset{x\to 0+}{Lt}\left(\left[\frac{1}{x}\right]+\left[\frac{2}{x}\right]+....\left[\frac{15}{x}\right]\right) \le \varepsilon 15$$

$$\varepsilon 120 < \underset{x\to 0+}{Lt}\left(\left[\frac{1}{x}\right]+\left[\frac{2}{x}\right]+....\left[\frac{15}{x}\right]\right) \le \varepsilon 120$$

By sandwich theorem

$$\underset{x\to 0+}{Lt}\ x\left(\left[\frac{1}{x}\right]+\left[\frac{2}{x}\right]+...+\left[\frac{15}{x}\right]\right)=120$$

$$\left[\frac{1}{x}\right] \le \frac{1}{x}$$

$$\left[\frac{2}{x}\right] \le \frac{2}{x}$$

$$\left[\frac{15}{x}\right] \le \frac{15}{x}$$

$$\left[\frac{1}{2}\right]+\left[\frac{2}{x}\right]+....+\left[\frac{15}{x}\right] \le \frac{\varepsilon 15}{x}$$

$$x\left(\left[\frac{1}{x}\right]+\left[\frac{2}{x}\right]+...+\left[\frac{15}{x}\right]\right) \le \varepsilon 15$$

$$\underset{x\to 0+}{Lt}\ x\left(\left[\frac{1}{x}\right]+\left[\frac{2}{x}\right]+...+\left[\frac{15}{x}\right]\right) \le \frac{15\times 16}{2}=120$$

45. **The value of** $\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \frac{\sin^2 x}{1+2^x}dx$ **is:**

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

2) 4π

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

4) $\frac{\pi}{8}$

Key: **3**

Sol: $A=\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \frac{\sin^2 x}{1+2^x}dx \to (1)$

$$A=\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \frac{\sin^2(-x)}{1+2^{-x}}dx \quad \left(\therefore \int_a^b f(x)dx=\int_a^b f(a+b-x)dx \to (1)\right)$$

$$(1)\&(2)\Rightarrow 2A=\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}}\left[\frac{\sin^2 x}{1+2^x}+\frac{2^x\sin^2 x}{1+2^x}\right]$$

$$2A=\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}}\sin^2 x\,dx$$

$$2A=2\left[\frac{1}{2}\times\frac{\pi}{2}\right]$$

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

46. **A bag contains 4 red and 6 black balls. A ball is drawn at random from the bag, its colour is observed and this ball along with two additional balls of the same colour are returned to the bag. If now a ball is drawn at random from the bag, then the probability that this drawn ball is red, is:**

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

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

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

4) $\frac{3}{10}$

Key: **1**

Sol:

R	B
4	6

Req. Prob $=\frac{4}{10}\times\frac{6}{12}+\frac{6}{10}\times\frac{4}{12}$

$=\frac{2}{5}\times\frac{1}{2}+\frac{2}{5}\times\frac{1}{2}=\frac{2}{5}$

47. **The length of the projection of the line segment joining the points $(5,-1,4)$ and $(4,-1,3)$ on the plane, $x+y+z=7$ is:**

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

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

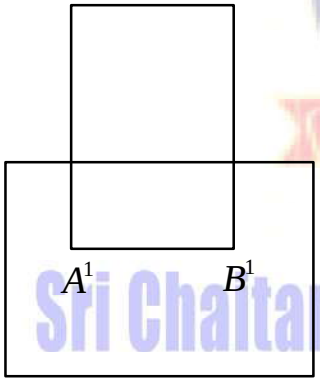
3) $\sqrt{\frac{2}{3}}$

4) $\frac{2}{\sqrt{3}}$

Key: **3**

Sol:

$A(5,-1,4)$ $B(4,-1,3)$



$x+y+z=7$

$$\frac{h-5}{1}=\frac{k+1}{1}=\frac{\ell-4}{1}=\frac{-1}{3}$$

$$h=\frac{14}{3},k=\frac{-4}{3},\ell=\frac{11}{3}$$

$$A^1=\left(\frac{14}{3},\frac{-4}{3},\frac{11}{3}\right)$$

$$\frac{h-4}{1}=\frac{k+1}{1}=\frac{\ell-3}{1}=\frac{1}{3}$$

$$h=\frac{13}{3},k=\frac{-2}{3},\ell=\frac{10}{3}$$

$$B^1 = \left(\frac{13}{3}, \frac{-2}{3}, \frac{10}{3}\right)$$

$$A^1B^1 = \sqrt{\left(\frac{14}{3} - \frac{13}{3}\right)^2 + \left(\frac{-4}{3} + \frac{2}{3}\right)^2 + \left(\frac{11}{3} - \frac{10}{3}\right)^2} = \sqrt{\frac{2}{3}}.$$

48. **If sum of all solutions of the equation** $8\cos x.\left(\cos\left(\frac{\pi}{6}+x\right).\cos\left(\frac{\pi}{6}-x\right)-\frac{1}{2}\right)=1$ **in** $[0,\pi]$ **is** $k\pi$ **, then** k **is equal to:**

1) $\frac{13}{9}$

2) $\frac{8}{9}$

3) $\frac{20}{9}$

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

Key: **1**

Sol: $8\cos x\left[\cos\left(\frac{\pi}{6}+x\right)\cos\left(\frac{\pi}{6}-x\right)-\frac{1}{2}\right]=1$

$$8\cos x\left(\frac{\pi}{6}+x\right)\cos\left(\frac{\pi}{6}-x\right)-4\cos x=1$$

$$8\cos x\left(\frac{3}{4}-1+\sin^2 x\right)-4\cos x=1$$

$$8\cos x\left[\frac{3}{4}-1+\cos^2 x\right]-4\cos x=1$$

$$8\cos x\left[\frac{3-4+4\cos^2 x}{4}\right]-4\cos x=1$$

$$-2\cos x+8\cos^{3x} x-4\cos x=1$$

$$8\cos^3 x-6\cos x=1$$

$$\cos 3x=\frac{2}{3}=\cos\frac{\pi}{3}$$

$$3x = 2n\pi \pm \frac{\pi}{3}$$

$$x = \frac{2n\pi}{3} \pm \frac{\pi}{3}$$

$$x = 0 \Rightarrow x = \frac{\pi}{4}$$

$$n = 1 \quad \Rightarrow \quad x = \frac{2\pi}{3} \pm \frac{\pi}{a} = \frac{6\pi}{9} + \frac{\pi}{9} = \frac{7\pi}{9}, \frac{5\pi}{9}$$

$$\therefore \sin = \frac{\pi}{9} + \frac{7\pi}{9} + \frac{5\pi}{9} = \frac{13\pi}{9}$$

$$\therefore \quad k = \frac{13}{9}$$

49. **A straight line through a fixed point (2,3) intersects the coordinate axes at distinct points P and Q. If O is the origin and the rectangle OPRQ is completed, then the locus of R is:**

1) $2x + 3y = xy$

2) $3x + 2y = xy$

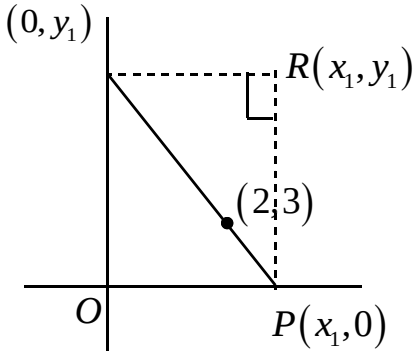
3) $3x + 2y = 6xy$

4) $3x + 2y = 6$

Key: **2**

Sol: **A straight line through fixed point (2, 3) intersects axes at P, Q. If O is consist of rectangle OPRQ is completed then locus of R is**

Let R be $(x_1, y_1) \Rightarrow P(x_1, 0)$ **&** $Q(0, y_1)$



$\therefore$ **equation of PQ is** $\frac{x}{x_1} + \frac{y}{y_1} = 1 \Rightarrow \frac{2}{x_1} + \frac{3}{y_1} = 1$ **But PQ passes through (R, S)** **Locus of R is** $\frac{2}{x} + \frac{3}{y} = 1$ **or** $3x + 2y = xy$

50. **Let A be the sum of the first 20 terms and B be the sum of the first 40 terms of the series** $1^2+2.2^2+3^2+2.4^2+5^2+2.6^2+....$
If $B-2A=100\lambda$**, then** λ **is equal to :**

1) 248

2) 464

3) 496

4) 232

Key: **1**

Sol: **Sum of 1st 2n terms** $=1^2+2.2^2+3^2+2.4^2+5^2+....+2(2n)^2$

$=\left(1^2+2^2+3^2+....+(2n)^2\right)+\left(2^2+4^2+....+(2n)^2\right)$

$=\frac{2n(2n+1)(4n+1)}{6}+\frac{4(n)(n+1)(2n+1)}{6}=n(2n+1)^2$

$\therefore A=10(21)^2 \quad B=20(41)^2$ **Given** $B-2A=100\lambda$

$\Rightarrow 20(41)^2-20(21)^2=100\lambda$

$\Rightarrow \lambda=248.$

51. **If the curves** $y^2=6x$, $9x^2+by^2=16$ **intersect each other at right angles, then the value of b is:**

1) $\frac{7}{2}$

2) 4

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

4) 6

Key: **3**

Sol: $y^2=6x\rightarrow(1)$

$2y\frac{dy}{dx}=6\Rightarrow\frac{dy}{dx}=\frac{3}{4}=M_1$

$ax^2+by^2=16$

$$18x+2by\frac{dy}{dx}=0$$

$$2by\frac{dx}{dy}=-18x$$

$$M_2=\frac{dy}{dx}=-\frac{18x}{2by}=\frac{-9x}{by}$$

$$M_1M_2=-1$$

$$\frac{3}{y_1}\frac{+18x_1}{by_1}=1-1\Rightarrow 27x_1=by_1^2$$

$$\Rightarrow 27x_1=ob(6x_1)\Rightarrow b=\frac{9}{2}$$

52. **Let the orthocenter and centroid of a triangle be $A(-3,5)$ and $B(3,3)$ respectively. If C is the circumcenter of this triangle, then the radius of the circle having line segment AC as diameter, is:**

1) $2\sqrt{10}$

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

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

4) $\sqrt{10}$

Key: **2**

Sol: **orthocentre and centroid of a triangle be $A(-3,5),B(3,3)$ C is circumcentre of triangle. Then radius of circle having line segment AC as diameter is**

Given centroid = B = (3, 3) orthocentre $A=(-3,5)$

circumcentre $=C=(6,2)$

$$\left[\because A+2C=3B(-3,5)+2C=(9,9)\Rightarrow C=(12,4)\Rightarrow C=(6,2)\right]$$

$$AC=\sqrt{81+9}=3\sqrt{10}$$

$$\therefore \textbf{radius}=\frac{AC}{2}=\frac{3\sqrt{10}}{2}=3\sqrt{\frac{10}{2}}$$

53. **Let** $S=\left(t\in R: f(x)=|x-\pi|.\left(e^{|x|}-1\right)\sin|x| \text{ is not differentiable at } t\right)$. **Then the set S is equal to:**

1) (0)

2) (π)

3) $(0,\pi)$

4) ϕ **(an empty set)**

Key: **4**

Sol: $S=|t\in R|$ $f(x)=|x-\pi|\left(e^{|x|}-1\right)\sin|x|$ **is not differentiable at t**

$$f'_{(0)}=\underset{x\to 0}{dt}\frac{f(x)-f(0)}{x}=\underset{x\to 0}{dt}\frac{|x-\pi|\left(e^{|x|}-1\right)\sin|x|}{x}=\mathbf{0}$$

$$f'_{(0)}=\underset{x\to \pi}{dt}\frac{g(x)-f(\pi)}{x-\pi}=\underset{x\to \pi}{dt}\frac{|x-\pi|\left(e^{|x|}-1\right)\sin(x)}{x-\pi}=0$$

54. **If** $\begin{vmatrix} x-4 & 2x & 2x \\ 2x & x-4 & 2x \\ 2x & 2x & x-4 \end{vmatrix}=(A+Bx)(x-A)^2$, **then the ordered pair (A, B) is equal to:**

1) $(-4,3)$

2) $(-4,5)$

3) $(4,5)$

4) $(-4,-5)$

Key: **2**

Sol: $\Delta\begin{vmatrix} x-4 & 2\lambda & 2x \\ 2x & 2-4 & 1x \\ 2x & 2x & x-4 \end{vmatrix}=(A+Bx)(x-A)^2$

$(A,B)=(-4,5)$

$$R_1+R_2+R_3 \Rightarrow R_1\ \Delta=(5x-4)\begin{vmatrix}1 & 1 & 1\\ 2x & x-4 & 2x\\ 2x & 2x & x-4\end{vmatrix}$$

$$=(5x-4)\begin{vmatrix}1 & 1 & 1\\ 2x & -(x+4) & 0\\ 2x & 0 & -(x+4)\end{vmatrix}$$

$$=(5x-4)(x+4)^2=(A+Bx)(x-A)^2$$

$A=-4 \quad B=5$

$\therefore (A,B)=(-4,5)$

55. **The Boolean expression $\sim(p\vee q)\vee(\sim p\wedge q)$ is equivalent to:**

1) p

2) q

3) ~q

4) ~p

Key: **4**

Sol: $\sim(p\vee q)v(\sim p\wedge q)\equiv(\sim P\wedge\sim q)\vee(\sim p\wedge q)$

$\equiv\sim(p\wedge\sim q)$

$\equiv\sim p\equiv\sim\wedge T$

$\equiv\sim p$

56. **If the system of linear equations**

$x+ky+3z=0$

$3x+ky-2z=0$

$2x+4y-3z=0$

Has a non-zero solution (x,y,z), then $\frac{xz}{y^2}$ is equal to:

1)10

2)–30

3)30

4) –10

Key: **1**

Sol: $\begin{vmatrix} 1 & k & 3 \\ 3 & k & -2 \\ 2 & 4 & -3 \end{vmatrix} = 0$

$\Rightarrow k = 11$

$x + 11y + 3z = 0$

$3x + 11y - 2z = 0$

$2x + 11y - 3z = 0$

$\frac{x}{5} = \frac{y}{-1} = \frac{z}{2}$

$\therefore \frac{xz}{yr} = \frac{5 \times 2}{(-1,2)} = 10$

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

1) contains exactly one element

2)contains exactly two element

3) contains exactly four element

4) is an empty set.

Key: **2**

Sol: $2\left|\sqrt{x} - 3\right| + \sqrt{x}\left(\sqrt{x} - 6\right) + 6 = 0$

if $\sqrt{x} > 3 \Rightarrow 2\sqrt{x} - 6 + x - 6\sqrt{x} + 6 = 0$

$-4\sqrt{x} + x = 0$

$x = 0 \; \sqrt{x} = 4$

if $\therefore \sqrt{x} = 4$ **if** $\sqrt{x} < 3 \; -2\sqrt{x} + 6 + x - 6\sqrt{x} + 6 = 0$

$x - 8\sqrt{x} + 12 = 0$

58. **If the tangent at $(1,7)$ to the curve $x^2 = y - 6$ touches the circle $x^2 + y^2 + 16x + 12y + c = 0$ then the value of c is:**

1)185

2)85

3)95

4) 195

Key: **3**

Sol: **Tangent at $(1,7)$ to the curve**

$x^2 = x - 6$ **is** $x(1) = \frac{1}{2}(y+7) - 6$

$2x - y + 5 = 0$

It touching the circle $x^2 + y^2 + 16x + 12y + c = 0$

$r = d$

$r^2 = d^2$

$100 - c = 5$

$c = 95$

59. **Let $y = y(x)$ be the solution of differential equation $\sin x \frac{dy}{dx} + y\cos x = 4x,\ x \in (0,\pi)$.**

It $y\left(\frac{\pi}{2}\right) = 0$. Then $y\left(\frac{\pi}{6}\right)$ is equal to:

1) $\frac{-8}{9\sqrt{3}}\pi^2$

2) $-\frac{8}{9}\pi^2$

3) $-\frac{4}{9}\pi^2$

4) $\frac{4}{9\sqrt{3}}\pi^2$

Key: **2**

Sol: $\frac{dy}{dx}+y\cot x=\frac{4x}{\sin x}$

if $=\sin x$

Given solution $y.\sin x=2x^2+C$

$$y\left(\frac{\pi}{2}\right)=0\Rightarrow 0=\frac{2\pi}{4}+C$$

$$C=\frac{-\pi r}{2}$$

$$\therefore y\sin x=2x^2\frac{-\pi^2}{2}$$

$$y\frac{1}{2}=\frac{2\pi^2}{36}\frac{-\pi^2}{2}$$

$$y\frac{1}{2}=\frac{\pi^2-9\pi^2}{18}$$

$$y\frac{1}{2}=\frac{-8\pi^2}{18}$$

$$y=\frac{-8\pi}{9}$$

60. **If L_1 is the line of intersection of the $2x-2y+3z-2=0$, $x-y+z+1=0$ L_2 is the line of intersection of the $x+2y-z-3=0$, $3x-y+2z-1=0$ the distance of the origin from the containing the lines L_1 and L_2 is:**

1) $\frac{1}{3\sqrt{2}}$

2) $\frac{1}{2\sqrt{2}}$

3) $\frac{1}{\sqrt{2}}$

4) $\frac{1}{4\sqrt{2}}$

Key: **1**

Sol: $\Rightarrow$ **point of Intersection of** $3x-2y+3x-2=0$

$x-y+z+1=0$

$\left(\frac{5}{7},\frac{8}{7},0\right)$

Drs L_1 **is** $(1,1,0)$

Drs L_2 **is** $(3,-5,-7)$

ε_a^n **phy** $\begin{vmatrix} x-5/7 & y-8/7 & z \\ 1 & 1 & 0 \\ 3 & -5 & -7 \end{vmatrix}=0$

$\left(x-\frac{5}{7}\right)(-7)-\left(y-\frac{8}{7}\right)(-7)+z(-8)=0$

$-7x+5+7y-8-87=0$

$-7x+7y-8z-3=0$

$-7x-7y+8z+3=0$ **....(1)**

Distance from (0,0,0) to (1)

$=\frac{3}{\sqrt{49+49+64}}=\frac{3}{9\sqrt{2}}=\frac{1}{3\sqrt{2}}.$

PHYSICS

61. **The Angular width of the central maximum in a single slit diffraction pattern is 60^0. The width of the slit is 1 μm. The slit is illuminated by monochromatic plane waves. If another slit of same width is made near it, young's fringes can be observed on a screen placed at a distance 50cm from the slits. If the observed fringe width is 1cm, what is slit separation Distance? (i.e distance between centers of each slit.)**

1) 50 μm

2) 75 μm

3) 100 μm

4) 25 μm

Key: **4**

Sol: $a = 1\mu m,\ \theta = 30^0$

$$\beta = \frac{D\lambda}{d}$$

$$d = \frac{D\lambda}{\beta} = \frac{50\times10^{-2}}{1\times10^{-2}} \times \frac{1}{2} \times 10^{-6}$$

$$= 25\times10^{-6} m$$

62. **An electron from various exited states of hydrogen atom emit radiation to come to the ground state. Let λ_n, λ_g be the de Broglie wave length of the electron in the n^{th} state and the ground state respectively. Let Λ_n be the wave length of the emitted photon in the transition from the n^{th} state to the ground state. For large n, (A, B are constants.)**

1) $\wedge_n \approx A + B\lambda_n$

2) $\wedge_n^{\ 2} \approx A + B\lambda_n^{\ 2}$

3) $\wedge_n^{\ 2} \approx \lambda$

4) $\wedge_n \approx A + \frac{B}{\lambda^2_n}$

Key: **4**

Sol: $2\pi r_n = n\lambda_n, r_n = n^2 r_0$; $\lambda_n = (2\pi r_0)n = \lambda_{gn}$

$$= \frac{1}{\Lambda_n} = R\left(1 - \frac{1}{n^2}\right)$$

$$= R\left(1 - \frac{\lambda_g{}^2}{\lambda_n{}^2}\right)$$

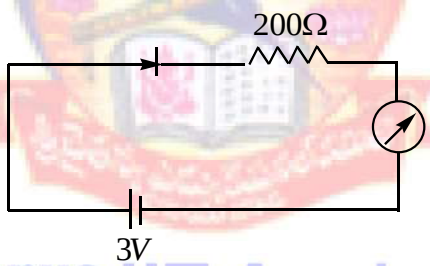
$$= \frac{R\left(\lambda_n{}^2 - \lambda_g{}^2\right)}{\lambda_n{}^2}$$

$$\Lambda_n = R\frac{\lambda_n{}^2}{\lambda_n{}^2 - \lambda_g{}^2}$$

$$= R\left[1 + \frac{\lambda_g{}^2}{\lambda_n{}^2}\right]$$

$$= A + B/\lambda_n{}^2$$

63. The reading of the ammeter for a silicon diode in the given circuit is:



1) 15mA

2) 11.5mA

3)13.5mA

4) 0

Key: **2**

Sol: $\tau = \frac{3 - 0.7}{200}$

$= 11.5mA$

64. **The density of a material in the shape cube is determined by measuring sides of the cube and its mass. Relative errors in measuring the mass length are respectively 1.5% and 1% maximum error in determining the density is:**

1) 3.5%

2) 4.5%

3) 6%

4) 2.5%

Key: **2**

Sol: $\rho = \frac{m}{L^3}$

$$\frac{\Delta\rho}{\rho} \times 100 = \left(\frac{\Delta m}{m} + \frac{3\Delta l}{l}\right)100$$

$$= 1.5 + 3 = 4.5$$

65. **An electron, a proton and an alpha particle having the same kinetic energy are moving in circular orbits of radii r_e, r_p, r_α, respectively in a uniform magnetic field B. The relation between r_e, r_p, r_α, is:**

1) $r_e < r_P = r_\alpha$

2) $r_e < r_P < r_\alpha$

3) $r_e < r_\alpha < r_P$

4) $r_e > r_P = r_\alpha$

Key: **1**

Sol:

$$r = \frac{\sqrt{2mKE}}{qB}$$

$$r \propto \frac{\sqrt{m}}{q} \rightarrow e^0\ {}_1H^1\ {}_2He^4$$

$$r_e < r_p = r_\alpha$$

66. **Three concentric metal shells A, B and C of respective radii a, b and c (a<b<c) have surface charge densities +σ, -σ and +σ respectively. The potential of shell B is:**

1) $\frac{\sigma}{\in_o}[\frac{a^2-b^2}{b}+c]$

2) $\frac{\sigma}{\in_o}[\frac{b^2-c^2}{b}+a]$

3) $\frac{\sigma}{\in_o}[\frac{b^2-c^2}{c}+a]$

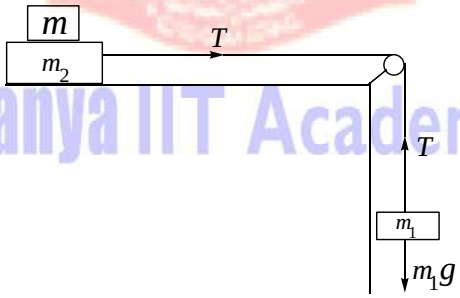
4) $\frac{\sigma}{\in_o}[\frac{a^2-b^2}{a}+c]$

Key: **1**

Sol: $V_B=\frac{1}{4\pi\in_0}\left[\frac{4\pi a^2\sigma}{b}+\frac{-4\pi b^2\sigma}{b}+\frac{4\pi c^2\sigma}{c}\right]$

$=\frac{\sigma}{\in_0}\left[\frac{a^2-b^2}{b}+c\right]$

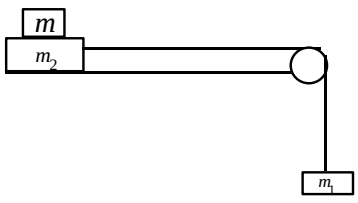
67. **Two masses $m_1=5kg$ and $m_2=10kg$ connected by an inextensible string over a Friction less pulley, are moving as shown in the figure. The coefficient of friction of horizontal surface is 0.15. The weight m that should be put on top of m_2 to stop the motion is:**



1) 27.3 kg
2) 43.3 kg
3) 10.3 kg
4) 18.3 kg

Key: **1**

Sol: $\mu(m+m_2)g\geq m_1g$



$m\geq\frac{m_1}{\mu}-m_2=23.33kg$ =27.3kg

68. **The particle is moving in a circular path of radius a under the action of an attractive potential U= -** $\frac{k}{2r^2}$ **its total energy is:**

1) $\frac{k}{2a^2}$

2) Zero

3) $\frac{-3}{2}\frac{k}{a^2}$

4) $-\frac{k}{4a^2}$

Key: **2**

Sol: $U=\frac{-K}{2r^2}\ F=-\frac{dU}{dr}=\frac{+k}{2}\times\frac{2}{r^3}=\frac{+k}{r^3}$

$$\frac{mv^2}{r}=\frac{k}{r^3}$$

$$k=\frac{1}{2}mv^2=\frac{+k}{2r^2}$$

$$=U+K.E=0$$

69. **A parallel plate capacitor of capacitance 90 pF is connected to a battery of emf 20v. If a dielectric material of dielectric constant** $k=\frac{5}{3}$ **is inserted between the plates, the magnitude of the induced charge will be:**

1) 0.3 n C

2) 2.4 n C

3) 0.9 n C

4) 1.2 n C

Key: **4**

Sol:

$$Q_{in} = Q_0\left(1-\frac{1}{k}\right)$$
$$= kc_0 v\left(1-\frac{1}{k}\right)$$
$$= \frac{5}{3}\times 90\times 10^{-9}\times 20\left(1-\frac{3}{5}\right)$$
$$= \frac{5}{3}\times 90\times 10^{-9}\times 20\times\frac{2}{5}$$
$$= 1.2nc$$

70. **A silver atom in a solid oscillates in simple harmonic motion in some direction with a frequency of 10^{12} / sec. What is the force constant of the bonds connecting one atom with the other? (Mole wt. of silver = 108 and Avogadro number $= 6.02\times 10^{23} gm\ mole^{-1}$)**

1) 7.1 N/m

2) 2.2 N/m

3) 5.5 N/m

4) 6.4 N/m

Key: **1**

Sol: $2\pi\times 10^{12} = \sqrt{\frac{12\times 6.02\times 10^{23}}{108\times 10^{-3}}}$

$$4\pi^2\times 10^{24} = \frac{12\times 6.02\times 10^{23}}{108\times 10^{-3}}$$
$$\frac{40\times 10^{24}\times 108\times 10^{-3}}{6\times 10^{23}} = 12$$
$$720\times 10^{-2} = 7.2\,N/m \approx 7.1\,N/m$$

71. **It is found that if a neutron suffers an elastic collinear collision with deuterium at rest, fractional loss of its energy is p_d; while for its similar collision with carbon nucleus at rest, fractional loss of energy is p_c. The values of p_d and p_c are respectively.**

1) (28, 89)

2) (0, 0)

3) (0, 1)

4) (89, 28)

Key: **4**

Sol: $m \to u \quad 2m \qquad mu = mv_1 + 2mv_2$

$2u = 2v_2 + 2v_1$ $\qquad 4 = 3v_1$

$-2u = -2v_2 + 2v_1 \rightarrow \left(\frac{1}{2}\frac{mu^2}{9}\right)$

$-4 = 3v_1$ $\qquad -\frac{4}{3} = v_1$

$f = \frac{\frac{1}{2}mu^2 \frac{1}{2}m\frac{u^2}{9}}{\frac{1}{2}mu^2}$ $\qquad = 1 - \frac{1}{9}$

$= \frac{8}{9} = 0.89$ $\qquad 80P_d = 0.89$

72. **The dipole moment of a circular loop carrying a current I, is m and the magnetic field at the centre of the loop is B_1. When the dipole moment is doubled by keeping the current constant, the magnetic field at the centre of the loop is B_2. The ratio $\frac{B_1}{B_2}$ is:**

1) $\sqrt{3}$

2) $\sqrt{2}$

3) $\frac{1}{\sqrt{2}}$

4) 2

Key: 2

Sol: $M_1 = \pi R_1^2 i$ $\qquad M_2 = \pi R_2^2 i$

$M_2 = 2M_1 \Rightarrow R_2 = \sqrt{2}R_1$

$B_1 = \frac{u_0 i}{2R_1}$ $\qquad B_2 = \frac{u_0 i}{2R_2}$

$\frac{B_1}{B_2} = \frac{R_2}{R_1} = \sqrt{2}$

73. **In a potentiometer experiment, it is found that no current passes through the galvanometer when the terminals of the cell are connected across 52cm of the potentiometer wire. If the cell is shunted by a resistance of 5Ω, a balance is found when the cell is connected across 40 cm of the wore. Find the internal resistance of the cell.**

1) 1.5 Ω

2) 2 Ω

3) 2.5 Ω

4) 1 Ω

Key: 1

Sol: $\frac{E}{\left(\frac{E}{r+R}\right)R}=\frac{52}{40}\Rightarrow\frac{R+r}{R}=\frac{52}{40}$

$\Rightarrow 1+\frac{r}{R}=\frac{52}{40}\qquad \frac{r}{R}=\frac{12}{40}$

$r=\frac{12}{40}\times R=\frac{12\times 5}{40}=1.5\Omega$

74. **A telephonic communication service is working at carrier frequency of 10GHz. Only 10% of it is utilized for transmission. How many telephonic channels can be transmitted simultaneously if each channel requires a bandwidth of 5 kHz**

1) 2×10^4

2) 2×10^5

3) 2×10^6

4) 2×10^3

Key: **2**

Sol: available band width

$\frac{10}{100}\times10\times10\,Hz=10$

Number of channels

$\frac{10^9}{5\times10^3}=2\times10^5$

75. **Unpolarized light of intensity I passes through an ideal polarizer A. Another Identical polarizer B is paced behind A. The intensity of light beyond B is found to be $\frac{1}{2}$. Now another identical polarizer C is placed between A and B. The intensity beyond B is now found to be $\frac{I}{8}$. The angle between polarizer A and C is:**

1) 30^0

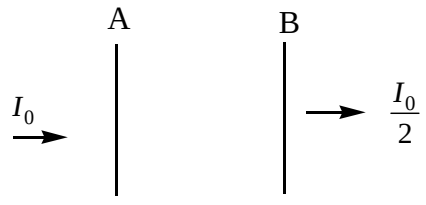
2) 45^0

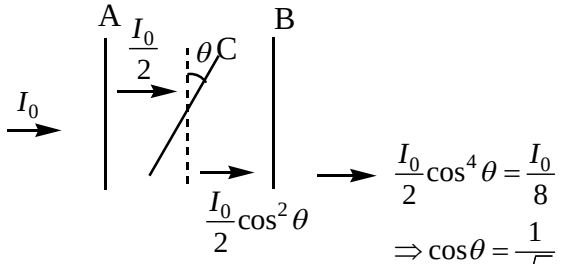
3) 60^0

4) 0^0

Key: **2**

Sol:





$\frac{I_0}{2}\cos^4\theta = \frac{I_0}{8}$

$\Rightarrow \cos\theta = \frac{1}{\sqrt{2}}$

$\Rightarrow \theta = 45^0$

76. **On interchanging the resistances, the balance point of a meter bridge shifts to the left by 10cm. The resistance of their series combination is 1kΩ. How much was the resistance on the left slot interchanging the resistances?**

1) 505Ω

2) 550Ω

3) 910Ω

4) 990Ω

Key: **2**

Sol: $l_1 + l_2 = 100m$ $\quad l_1 - l_2 = 10cm$

$l_1 = 53m$

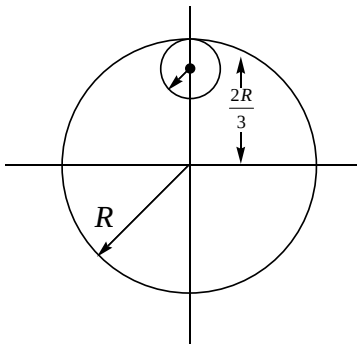
$l_2 = 45m$

$R_1 + R_2 = 1000\Omega$

$\frac{R_1}{R_2} = \frac{l_1}{l_2}$ $\quad R_1 = \frac{l_1}{l_1 + l_2} \times 1000$

$= \frac{55}{100} \times 1000 = 550\Omega$

77. **From a uniform circular disc of radius R and mass 9M, a small disc of radius $\frac{R}{3}$ is removed as shown in the figure. The moment of inertia of the remaining disc about an axis perpendicular to the plane of the disc and passing through centre of disc is:**



1) $\frac{40}{9} MR^2$

2) $10\ MR^2$

3) $\frac{37}{9} MR^2$

4) $4\ MR^2$

Key: **4**

Sol: $M = \sigma \times \frac{\pi R^2}{9}$

$\sigma = \frac{9M}{\pi R^2} = \text{M}$

$I = \frac{9MR^2}{2} - \left(\frac{MR^2}{9 \times 2} + \frac{M\,4R^2}{9} \right)$

$I = 4MR^2$

78. **In collinear collision, a particle with an initial speed v_0 strikes a stationary particle of the same mass. If the final total kinetic energy is 50% greater than the original kinetic energy, the magnitude of the relative velocity between the two particles, after collision, is:**

1) $\sqrt{2}\,v_0$

2) $\frac{v_0}{2}$

3) $\frac{v_0}{\sqrt{2}}$

4) $\frac{v_0}{4}$

Key: **1**

Sol: $KE_f = \frac{1}{2}(2m)v_{cm}^2 + \frac{1}{2}u\,v_{res}^2$

$= \frac{1}{2}(2m)\left(\frac{v_0}{2}\right)^2 + \frac{1}{2}\left(\frac{m}{2}\right)v_{res}^2$

$KE_f = \frac{3}{2}KE_i$

$= \frac{1}{2}(2m)\left(\frac{v_0^{\,2}}{4}\right) + \frac{1}{2}\left(\frac{m}{2}\right)v_{res}^2 = \frac{3}{2}\times\frac{1}{2}mv_0^{\,2}$

$\Rightarrow v_0^{\,2} + v_{res}^2 = 3v_0^{\,2} \quad \Rightarrow v_{res} = \sqrt{2}v_0$

79. **An EM wave from air enters a medium. The electric fields are** $\vec{E_1} = E_{01}\hat{x}\cos\left[2\pi v\left(\frac{z}{c} - t\right)\right]$ **in air and** $\vec{E_2} = E_{02}\hat{x}\cos\left[k(2z - ct)\right]$ **in medium, where the wave number k and frequency v refer to their values in air. The medium is non-magnetic. If** $\in_{r_1}$ **and** $\in_{r_2}$ **refer to relative permittivites of air and medium respectively, which of the fallowing options is correct?**

1) $\frac{\in_{r_1}}{\in_{r_2}} = 2$

2) $\frac{\in_{r_1}}{\in_{r_2}} = \frac{1}{4}$

3) $\frac{\in_{r_1}}{\in_{r_2}} = \frac{1}{2}$

4) $\frac{\in_{r_1}}{\in_{r_2}} = 4$

Key: 2

Sol: speed of light in medium 2 is $\frac{c}{2}$ So $c=\frac{1}{\sqrt{u_r u_0 \in_0 \in_r}}$ $u_r=1$

$\in_{r_2}=4$

80. **For an RLC circuit driven with voltage of amplitude v_m and frequency $\omega_o=\frac{1}{\sqrt{LC}}$ the current exhibits resonance. The quality factor, Q is given by:**

1) $\frac{\omega_o R}{L}$

2) $\frac{R}{(\omega_o C)}$

3) $\frac{CR}{\omega_o}$

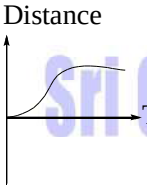
4) $\frac{\omega_o L}{R}$

Key: 4

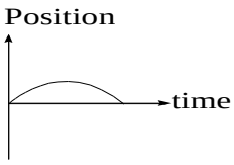
Sol: $Q-factor=\frac{\text{Resonance frequency}}{\text{bandwidth}}=\frac{\omega_0 L}{R}$

81. **All the graphs below are intended to represent the same motion. One of them does it incorrectly, pick it up.**

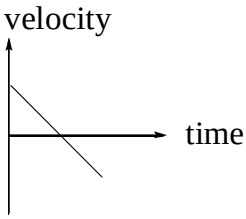
1)



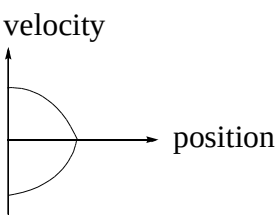
2)



3)



4)



Key: 1

Sol: options 2, 3, 4 represent similar type of motion where as option 1 is different.

82. **Two batteries with e.m.f. 12V and 13V are connected in parallel across a load resistor of 10Ω. The internal resistance of the two batteries is 1Ω and 2Ω respectively. The voltage across the load lies between:**

1) 11.5 V and 11.6 V

2) 11.4 V and 11.5 V

3) 11.7 V and 11.8 V

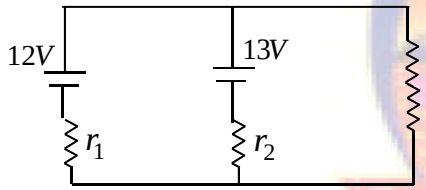
4) 11.6 V and 11.7 V

Key: 1

Sol: $\in_1 = 12v,\ r_1 = 1\Omega$

$\in_2 = 13v, r_2 = 2\Omega$

$R = 10\Omega$



$$\in = \frac{\frac{\in_1}{r_1} + \frac{\in_2}{r_2}}{\frac{1}{r_1} + \frac{1}{r_2}} = \frac{\frac{12}{1} + \frac{13}{2}}{\frac{1}{1} + \frac{1}{2}} = \frac{24+13}{3} = 12.33$$

$$req = \frac{r_1 r_2}{r_1 + r_2} = \frac{2}{3} \qquad v_{load} = \frac{10}{10 + \frac{2}{3}} \times \frac{37}{3} = \frac{10}{32} \times 37 = 11.56v$$

83. **A particle is moving with a uniform speed in a circular orbit of radius R in a central force universally proportional to the n^{th} power of R. If the period of rotation of the particle is T, then:**

1) $T \propto R^{\frac{n}{2}+1}$

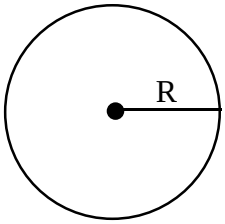
2) $T \propto R^{(n+1)/2}$

3) $T \propto R^{n/2}$

4) $T \propto R^{3/2}$ for any n.

Key: 2

Sol:



$$f_c \propto \frac{1}{R^n}$$

$$\frac{mv^2}{R} \propto \frac{1}{R^n} \Rightarrow v \propto n^{\frac{-(n-1)}{2}}$$

$$T = \frac{2\pi R}{v} \propto R^{1+\frac{(n-1)}{2}} = R^{\frac{n+1}{2}}$$

84. **If the series limit frequency of the Lyman series is ϑ_L, then the series limit frequency of the Pfund series is:**

1) $16\vartheta_L$

2) $\frac{\vartheta_L}{16}$

3) $\frac{\vartheta_L}{25}$

4) $25\vartheta_L$

Key: **3**

Sol: **Limit frequency v_L of Lyman series**

$$hv_L = k\left(1-\frac{1}{\infty^2}\right) \rightarrow n_1 = 1, n_2 = \infty$$

$$hv_P = k\left(\frac{1}{25}-\frac{1}{\infty^2}\right) \rightarrow n_1 = 5, n_2 = \infty$$

$$\Rightarrow v_P = \frac{v_L}{25}$$

85. **In an a.c circuit, the instantaneous e.m.f. and current are given by** $e = 100\sin 30t$

$$i = 20\sin\left(30t - \frac{\pi}{4}\right)$$

In one cycle of a.c., the average power consumed by the circuit and the wattless current are, respectively:

1) $\frac{1000}{\sqrt{2}}, 10$

2) $\frac{50}{\sqrt{2}}, 0$

3) $50, 0$

4) $50, 10$

Key: 1

Sol:

$$e = 100\sin 30t$$

$$i = 20\sin\left(30 - \frac{\pi}{4}\right)$$

$$P_m = I_m V_m \cos\phi$$

$$= \frac{100}{\sqrt{2}} \times \frac{20}{\sqrt{2}} \times \cos\frac{\pi}{4}$$

$$= \frac{1000}{\sqrt{2}} W$$

Wattless current $= \frac{20}{\sqrt{2}}\sin 45^0 = \frac{20}{2} = 10A$

86. **Two moles of an ideal monotonic gas occupies a volume V at $27^0 C$. The gas expands adiabatically to a volume 2V. Calculate (a) the final temperature of the gas and (b) change in its internal energy.**

1) (a) 195 K (b) -2.7 kJ

2) (a) 189K (b) -2.7 kJ

3) (a) 195K (b) 2.7 kJ

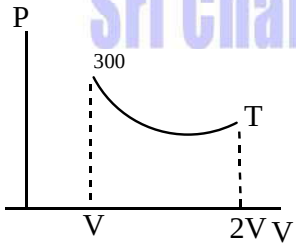
4) (a) 189K (b) 2.7 kj

Key: 2

Sol:

$$Pv^{\gamma} = Const$$

$$Tv^{\gamma-1} = Const$$



$$\gamma - 1 = \frac{2}{3} monoatomic\ gas \qquad \Rightarrow Tv^{2/3} = Const$$

$$300v^{2/3} = T(2v)^{2/3} \quad T = \frac{300}{2^{2/3}} \approx 189K$$

$$\Delta v = nC_v\Delta t \qquad \approx -2.7kJ$$

$$n = 2;\ Cv = \frac{3R}{2}$$

$$\Delta T = 189 - 300 = -111K$$

87. **A solid sphere radius r made of a soft material of bulk modulus K is surrounded by a liquid in a cylindrical container. A mass less piston of area a floats on the surface of the liquid, covering entire cross section of cylindrical container. When a mass m is placed on the surface of the piston to compress the liquid, the fractional decrement in the radius of the sphere, $\left(\frac{dr}{r}\right)$, is:**

1) $\frac{Ka}{3mg}$

2) $\frac{mg}{3Ka}$

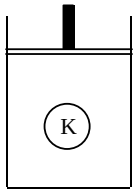
3) $\frac{mg}{Ka}$

4) $\frac{Ka}{mg}$

Key: **2**

Sol: **Bulk modulus =K,** $\frac{\Delta v}{v}=\frac{3\Delta r}{r}$

$K=-\frac{P}{\frac{\Delta v}{v}}\quad p=\frac{mg}{a}$



$\frac{\Delta v}{v}=\frac{mg}{aK}$

$3\frac{dr}{r}=\frac{mg}{aK}$

$\frac{dr}{r}=\frac{mg}{3Ka}$

88. **A granite rod of 60cm length is clamped at its middle point and is set into longitudinal vibrations. The density of granite is $2.7\times10^{3}kg/m^{3}$ and its Young's modulus is $9.27\times10^{10}Pa$. What will be the fundamental frequency of the longitudinal vibrations?**

1) $2.5\,kHz$

2) $10\,kHz$

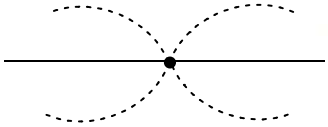
3) $7.5\,kHz$

4) $5\,kHz$

Key: **4**

Sol: $\delta = 2.7\times10^{3}kg/m^{2}$

$y = 9.27\times10^{10}Pa$



$$\frac{\lambda_0}{2} = l = 60Cm$$

$$\forall = \sqrt{\frac{Y}{\delta}} = \sqrt{\frac{9.27\times10^{10}}{2.7\times10^{3}}} = 5.85\times10^{2}$$

$$f = \frac{\forall}{\lambda} = \frac{5.8\times10^{2}}{2\times6\times10^{-2}} = \frac{9.7\times10^{3}}{2}, n_2 \approx 5kHz$$

89. **The mass of a hydrogen molecule is $3.32\times10^{-27}\,kg$. if 10^{23} hydrogen molecules strike, per second, a fixed wall of area $2cm^{2}$ at an angle of 45^{0} to the normal, and rebound elastically, with a speed of $10^{3}\,m/s$, then the pressure on the wall is nearly:**

1) $4.70\times10^{3}\,N/m^{3}$

2) $2.35\times10^{2}\,N/m^{3}$

3) $4.70\times10^{2}\,N/m^{3}$

4) $2.35\times10^{3}\,N/m^{3}$

Key: **4**

Sol: $m_{H_2} = 3.32\times10^{-27}kg$

No of Atoms $hits/\sec(n) = 10^{23}, v = 10^{3}m/s$

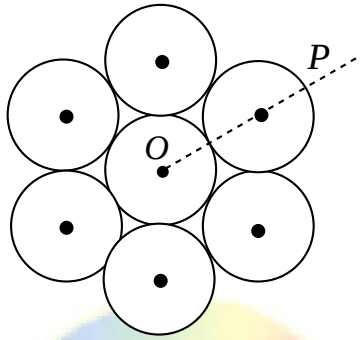
$A = 2m^{2} = 2\times10^{-4}m^{2}, \theta = 45^{0}$

$$f = \frac{2nmv\cos\theta}{A} = 2\times10^{23}\times3.32\times10^{-27}\times10^{3}\times\frac{1}{\sqrt{2}\times2\times10^{-4}}$$

$= 2.347 \times 10^3 N / m^2$

$= 2.35 \times 10^3 N / m^2$

90. **Seven identical circular planar disks, each of mass M and radius R are welded symmetrically s shown. The moment of inertia of the arrangement about the axis normal to the plane and passing through the point P is:**



1) $\frac{55}{2}MR^2$

2) $\frac{73}{2}MR^2$

3) $\frac{181}{2}MR^2$

4) $\frac{19}{2}MR^2$

Key: **3**

Sol:

$$I_p = \frac{55MR^2}{2} + 7M(3R)^2$$

$$= \left(\frac{55}{2} + 63\right)MR^2$$

$$= \frac{181}{2}MR^2$$