ALL INDIA OPEN TEST (AIOT)
(JEE MAIN PATTERN)

TARGET : JEE (MAIN+ADVANCED) 2018

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HINTS & SOLUTIONS

PART-A : PHYSICS

1. A beaker ....

Sol. Real depth = r.i. (apparent depth)

In the first case,

Real depth, h_1, = $\mu(b - a)$

In the second case,

Real depth, h_2, = $\mu(d - c)$

Since, $h_2 > h_1$, the difference of real depth

$h_2 - h_1 = \mu[d - c - b + a]$

Since, liquid is added

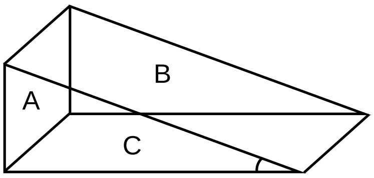
$\therefore \quad h_2 - h_1 = d - b$

$\therefore \quad d - b = \mu(d - c - b + a)$

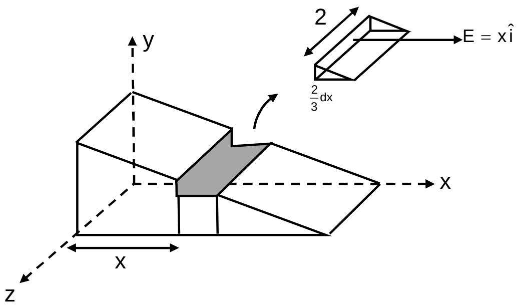
$$\therefore \quad \mu = \frac{d-b}{d-c-b+a}$$

2. Electric field ....

Sol. Flux through A in zero as area is $\perp$ to $\vec{E}$ total flux due to B and C due to y component of E.F. is zero. Net flux is only due to x-component of E.F. due to B.



$$d\phi = x \times 2 \times \frac{2}{3}dx = \frac{4x}{3}dx$$



$$\therefore \quad \phi = \int_0^3 \frac{4x}{3}dx = \left.\frac{4x^2}{3}\right|_0^3 = 6$$

$$\phi = \frac{q}{\varepsilon_0} = 6$$

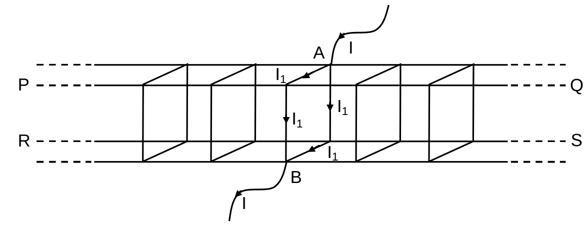
$Q = 6\varepsilon_0$

4. The vernier ....

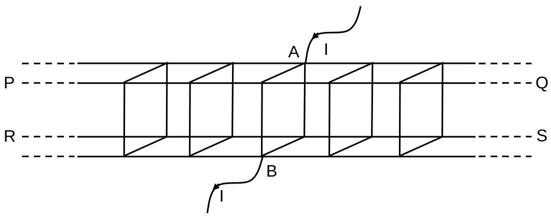
Sol. Least count $= \left(1 - \frac{49}{50}\right)0.5° = \frac{1°}{100} = 0.6'$

5. The network..................

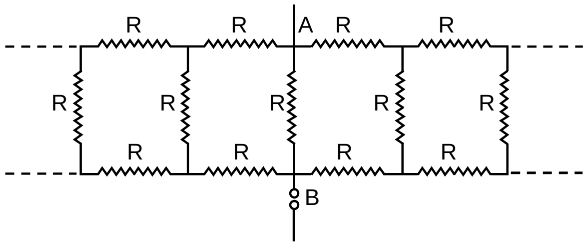
Sol.



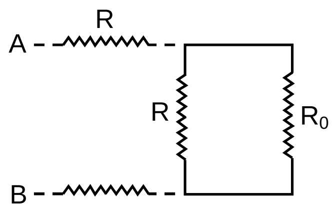
No current flows in line PQ and RS.



So, the given network is equivalent to



Let equivalent resistance on either side of AB = R_0



$$2R + \frac{RR_0}{R + R_0} = R_0$$

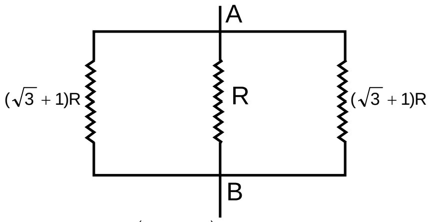
$= R^2 + 2RR_0 + RR_0 = RR_0 + R_0^2$

$R_0^2 - 2RR_0 - 2R^2 = 0$

$$R_0 = \frac{2R + \sqrt{4R^2 + 8R^2}}{2}$$

$$R_0 = \frac{2R + 2\sqrt{3}R}{2} = (\sqrt{3} + 1)R$$

So, the given network is equivalent to



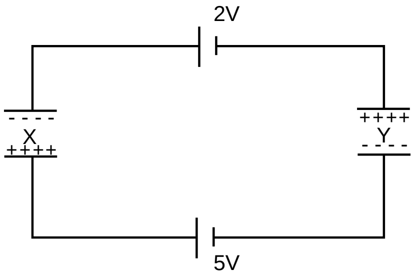
$\therefore \quad R_{AB} = \dfrac{R \times \dfrac{(\sqrt{3}+1)R}{2}}{\left(1+\dfrac{\sqrt{3}+1}{2}\right)R} = \dfrac{(\sqrt{3}+1)R}{(\sqrt{3}+3)} = \dfrac{R}{\sqrt{3}}$

6. Four metallic ....

Sol. Charge on each capacitor is

$q = \dfrac{3C}{2}$

Electric field between plates = $\dfrac{q}{A\varepsilon_0}$



$V_x + \dfrac{Ed}{2} - 5 + \dfrac{Ed}{2} = V_y$

$V_y - V_x = Ed \ -5$

$= \dfrac{q}{\varepsilon_0 A} d - 5 = \dfrac{q}{C} - 5 = \dfrac{3C/2}{C} - 5 = \dfrac{3}{2} - 5$

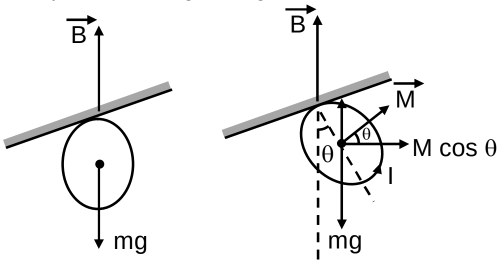
$= -3.5$ V

$W_{e\ell} = \quad q(V_y - V_x) = (-e)\,(-3.5)$

7. A uniform ....

Sol. torque due to magnetic field = MB cos θ

Torque due to weight = mgR sin θ



No current after current

In equilibrium

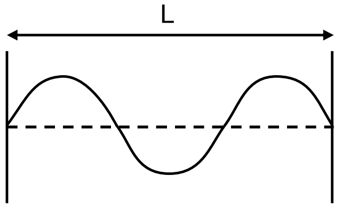
mgR sin θ = MB cos θ = $I\pi R^2$ cos θ B

$\tan\theta = \dfrac{\pi IRB}{mg} \Rightarrow \theta = \tan^{-1}\left(\dfrac{\pi IRB}{mg}\right)$

$\therefore$ maximum angular deflection = $2\tan^{-1}\left(\dfrac{\pi IRB}{mg}\right)$

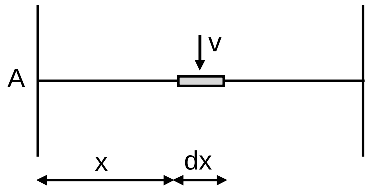
8. A standing ....

Sol. In 3^{rd} harmonic



$y = 2A\sin\left(\dfrac{3\pi x}{L}\right)\cos(\omega t)$

Max. emf will be when string will become horizontal.



Amp at position x = $2A\sin\left(\dfrac{3\pi}{x}\right)$

Velocity at position x, = $2A\sin\left(\dfrac{3\pi x}{L}\right)\omega$

$\therefore \quad d\varepsilon = v\,B\,dx$

$= B.2\pi\omega.\sin\left(\dfrac{3\pi x}{L}\right)dx$

Total emf $\varepsilon = 2A\omega B\displaystyle\int_0^L \sin\left(\dfrac{3\pi x}{L}\right)dx = \dfrac{4A\omega B}{k}$

9. An A.C. ....

Sol. If in A.C. circuit there are only L and C, phase difference between applied voltage can be either zero or π. So, 'a' can't be the answer.

10. There is ....

Sol. Induced E.F. outside magnetic region

$E = \dfrac{R^2}{2r}\dfrac{dB}{dt}$

$r = R_1, \ \dfrac{dB}{dt} = \beta$

$= \dfrac{R^2}{2R_1}\beta$

$dV = -\vec{E}.d\vec{l}$

$\therefore \quad \Delta v = \varepsilon = \displaystyle\int \varepsilon_1.d\vec{l} = \dfrac{R^2}{2R_1}\beta.R_1\theta$

$= \dfrac{R^2}{2}\theta\beta$

11. When light ....

Sol. $2\mu t = \frac{(2n-1)\lambda}{2}$ for max.

$2\mu t = n\lambda$ for min.

For min. $2 \times 1.33 \times t = (4500\,\overset{o}{A})n$ …(i)

For max. $2 \times 1.33 \times t = \left(\frac{6000}{2}\overset{o}{A}\right)(2n-1)$ …(ii)

Solving n = 2

Put n = 2 in 1

$T = 3383\,\overset{o}{A}$

12. Magnetic ....

Sol. Frequency of rev = ν

$\therefore$ $I = e\nu$

$\therefore$ $B = \frac{\mu_0 I}{2r}$

$B = \frac{\mu_0 e\nu}{2r}$

$= \left(\frac{\mu e}{2}\right)\frac{\nu}{2\pi r}\left(\frac{1}{r}\right) = \left(\frac{\mu e}{4\pi}\right)\frac{e.\nu}{r^2}$

In hydrogen atom

$$v = \frac{nh}{2\pi mr}$$

$\therefore$ $B = \frac{\mu_0}{4\pi}\frac{eh.n}{(4\pi m)r^3}$

and $r = \frac{\varepsilon_0 h^2 n^2}{\pi me^2}$

$\therefore$ $B = \frac{\mu_0 \pi m^2 e^7}{8\varepsilon_0 h^5 n^5}$

$\therefore$ $B \propto e^7$

$B \propto \frac{1}{n^5}$

13. The mean ....

Sol. $\lambda_{(\alpha+\beta)} = \lambda_\alpha + \lambda_\beta$

$\Rightarrow \frac{1}{T_{\frac{1}{2}(\alpha+\beta)}} = \frac{1}{T_{\frac{1}{2}(\alpha)}} + \frac{1}{T_{\frac{1}{2}(\beta)}}$

$\Rightarrow \frac{1}{T_{\frac{1}{2}(\alpha+\beta)}} = \frac{1}{30} + \frac{1}{60} = \frac{1}{20}$

$\therefore$ $T_{\frac{1}{2}(\alpha+\beta)}$ = 20 years

$\therefore$ One-fourth of sample will remain after 2 half life = 40

n2 years.

14. In a common ....

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

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

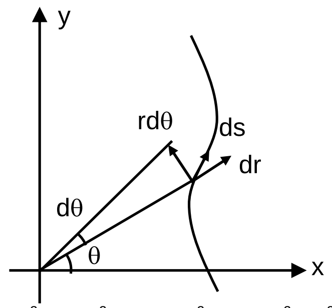
$G = 25\frac{R_{out}}{25} \times 0.03$ ......(i)

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

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

15. A particle is ....

Sol. $ds^2 = (dr)^2 + (rd\theta)^2$



$ds^2 = (d\theta)^2 + (\theta\,.\,d\theta)^2 = (1+\theta^2)\,d\theta^2$

$\therefore$ $ds = \sqrt{1+\theta^2}\,d\theta$

$\therefore$ $s = \int_0^{2\pi}\sqrt{1+\theta^2}\,d\theta$

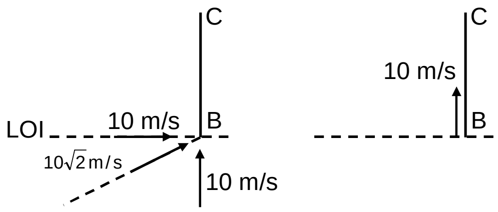
$= \frac{2\pi\sqrt{1+4\pi^2} + \ln|2\pi + \sqrt{1+4\pi^2}|}{2}$

16. A particle is ....

Sol. Velocity of particle just before hitting BC;

$v = \sqrt{20^2 - 2\times10\times10} = 10\sqrt{2}$ m/s

Collision with BC



Just before Just after

Since BC is smooth particle will hit BA with velocity 10 m/s.

Collision with BA

Just before just after

Motion along BA

Final velocity at A

$v^2 = (5\sqrt{2})^2 + 2 \times 10 \times 10 = 250$

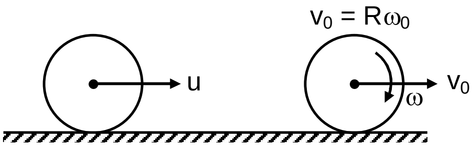
$v = 5\sqrt{10}$ m/s

17. Centre of mass ....

Sol. Let v_0 = velocity when pure rolling starts

Conservation of angular momentum about lowest point,

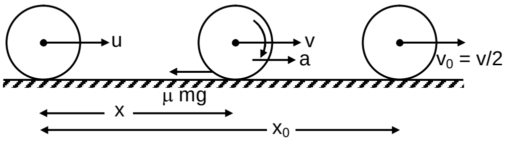
$muR = mv_0R + mR^2\left(\frac{v_0}{R}\right) = 2mv_0R \Rightarrow v_0 = \frac{u}{2}$



at position x, a = – μg

$$v\frac{dv}{dx} = -kxg$$

$$\int_u^{u/2} vdu = -\int_0^k kg\,xdx$$



$$\frac{1}{2}\left[\frac{u^2}{4} - u^2\right] = -kg\frac{u^2}{2}$$

$$x_0 = \sqrt{\frac{3}{4kg}}u$$

18. Water enters ....

Sol. $\tau = 2(\rho av^2)R = \frac{2\rho(av)^2}{a}R$

19. Two waves ....

Sol. Resultant wave

$y = y_1 + y_2$

$= \frac{5}{(3x-4t)^2+2} - \frac{5}{(3x+4t-6)^2+2}$ ...(i)

y = 0 when 3x – 4t = 3x + 4t – 6 $\Rightarrow t = \frac{6}{8} = \frac{3}{4}s$

y can also be written as

$y = \frac{5}{(4t-3x)^2+2} - \frac{5}{(3x+4t-6)^2+2}$ ...(ii)

Again

y = 0 when 4t – 3x = 3x + 4t – 6

x = 1 m

20. In the system ....

Sol. Compression in the spring

$$X = \frac{\mu mg}{K}$$

Applying work energy theorem on piston

$Wg = -W_{sp} - W\ atm = \frac{1}{2}Kx^2 + P_0.x\,A$

$$= \frac{\mu^2 m^2 g^2}{2K} + \frac{P_0\mu mg}{K}$$

$Q = W_g + \Delta U$

$= Wg$

$$= \frac{\mu_0 mg}{K}\left[AP_0 + \frac{\mu mg}{2}\right]$$

21. S_1 and S_2 ....

Sol. Let initial phase of $S_1 = \theta_1$ and t of $S_2 = \theta_2$

$\therefore\ \Delta\theta = \theta_1 - \theta_2 = \frac{\pi}{2}$

At P_1 $\quad \Phi_1 = k\,\Delta P - \Delta\theta = 0 - \frac{\pi}{2}$

At P_2 $\quad \Phi_2 = k\Delta P - \Delta\theta$

$= 2\pi \times \frac{\lambda}{2} - \frac{\pi}{2} = \pi - \frac{\pi}{2} = \frac{\pi}{2}$

$\therefore$ Resultant intensity at P_2 is same that of P_1

22. A particle ....

Sol. $a = A\sin\omega t_0$

$b = A\sin 2\omega t_0$

$c = A\sin 3\omega t_0$

$a + c = 2A\sin 2\omega t_0 \cos\omega t_0$

$\frac{a+c}{2b} = \cos\omega t_0$

$w = \frac{1}{t_0}\cos^{-1}\left(\frac{a+c}{2b}\right)$

$f = \frac{1}{2\pi t_0}\cos^{-1}\left(\frac{a+c}{2b}\right)$

23. The rubber ....

Sol. Elastic energy $E = \frac{1}{2}Y\,(\text{strain})^2\,(\text{volume})$

$E = \frac{1}{2}\times 6\times 10^8\left(\frac{0.05}{0.20}\right)^2\left(2\times 10^{-6}\times 0.25\right) = 9.375J$

The elastic energy is converted into kinetic energy.

$E = \frac{1}{2}mv^2$

$\upsilon = \sqrt{\frac{2E}{m}} = \sqrt{\frac{2\times 9.375}{15\times 10^{-3}}} = 35.3\,m/s$

24. A body emits ....

Sol. $\lambda_m T = b - 3\times 10^{-3}$ m K (Wien's Law)

$\frac{dE}{dt} = \sigma T^4$ (Boltzmann law)

$\lambda'_m = 2\lambda_m = 2\times 480 = 960$ nm.

25. A sinusoidal ....

Sol. $E_c = \frac{110+90}{2} = 100$

$E_m = \frac{110-90}{2} = 10$

modulating index m = $\frac{E_m}{E_c}$ = 0.1

amplitude of side band m × $\frac{E_c}{2}$ = 5 V

26. A wire bent ....

Sol. Since the wire is continuous, tension in the parts AB and BC will be identical. Equating the horizontal and vertical components of forces separately

$\frac{m\upsilon^2}{r} = T\sin 30° + T\sin 60°$ (i)

mg = T cos 30° + T cos60° (ii)

As the right-hand sides of (i) and (ii) are identical

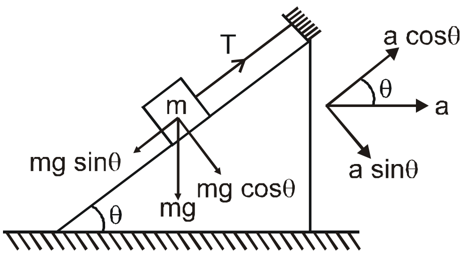
$\frac{m\upsilon^2}{r} = mg$

or $\upsilon = \sqrt{gr}$

27. In the given ....

Sol. v = $\frac{t^2}{2}$

a = t



At the instant when the normal is just zero

mg cosθ = ma sinθ

a = g cot θ

since θ = 45°

a = t = 10

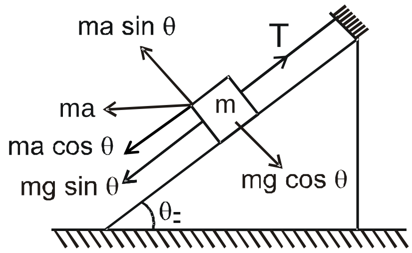
⇒ t = 10 sec.

Alternative solutions

v = $\frac{t^2}{2}$

a = t

Normal will be zero at the instant ma sin θ = mg cos θ



a = g cot θ

since θ = 45°

a = t = 10

⇒ t = 10 sec.

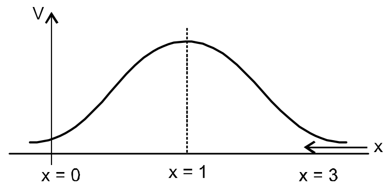
28. The electromagnetic ....

Sol. In electromagnetic radiations the rays with increasing energy or decreasing wavelength are,

RW > μW > IR > visible light > UV > X-rays> γ-ryas

29. A particle of ....

Sol.



to send the particle from x = 3 to x = 0, the particle has to be sent to the point (x = 1) where force changes the direction

So by applying energy conservation between x = 3 to x = 1

$K_i + U_i = K_f + U_f$

$\frac{1}{2} mu^2 + \frac{10}{4+(3-1)^2} = 0 + \frac{10}{4+(1-1)^2}$

Solving $u = \frac{\sqrt{5}}{2}$ m/s

30. Plane surface ....

Sol. Focal length of silvered mirror

$\frac{1}{f} = \frac{1}{f_m} - \frac{2}{f_\ell}$

$\frac{1}{f} = \frac{1}{\infty} - \frac{2}{f_\ell}$

f = $-\frac{f_\ell}{2}$

$\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$

$\frac{1}{-60} + \frac{1}{-30} = \frac{1}{f}$

f = –20 cm

Focal length of unsilvered lens will be 40 cm

So, $\frac{1}{v} + \frac{1}{30} = \frac{1}{40}$

$\frac{1}{v} = \frac{1}{40} - \frac{1}{60} = \frac{3-2}{120} = +\frac{1}{120}$

⇒ v = 120 cm.

PART-B : CHEMISTRY

31. The rate constant of ....

Sol. R = K [A]

R = $4 \times 10^{-3} \times 0.02$ = 8×10^{-5} M sec^{-1}

32. The volume-temperature ....

Sol. The correct order of pressure is

$p_1 > p_3 > p_2$ (For same volume & moles $p \propto T$).

35. What is the value of ....

Sol. $\alpha = \dfrac{7.8}{390} = 2\times10^{-2}$

$K_a = c\alpha^2 = 16\times10^{-6}$

or $pK_a = 4.8$

37. 1 mol CH_3COOH is ....

Sol. $\Delta T_b = i\ K_b .m$

Given molality = $\dfrac{1\times1000}{250}$ = 4m, 6.4

= $i \times 2 \times 4$ or i = 0.8

For dimerisation

$i = 1 - \dfrac{\beta}{2}$

$\Rightarrow\ 0.8 - 1 = \dfrac{-\beta}{2}$

or $\beta = 0.4$ $\Rightarrow$ 40%

38. Potassium crystallizes ....

Sol. distance between nearest neighbours = $2R = \dfrac{5.2\times\sqrt{3}}{2}$

= 4.5 Å

39. An acidic buffer solution ....

Sol. For given buffer solution $pH_1 = pKa$

Now 9 mL of 1 M HCl is added to (10 + x) mL of this solution

NaA	+	HCl	$\longrightarrow$	HA	+	NaCl
$1\times(10+x)$		(1×9)		$1(10+x)$		0
$(10+x)-9$		0		$(10+x)+9$		

$pH_1 - pH_2 = 1$

$\log \dfrac{(10+x)-9}{(10+x)+9} = -1$

$\dfrac{10+x-9}{10+x+9} = \dfrac{1}{10}$

x = 1 mL.

41. Bromine water reacts ....

Sol. $SO_2 + Br_2 + 2H_2O \longrightarrow 2HBr + H_2SO_4$

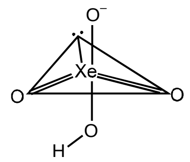
43. The xenate ion undergoes ....

Sol. $2HXeO_4^- + 2OH^- \longrightarrow XeO_6^{4-} + Xe + O_2 + 2H_2O$

$HXeO_4^-$ **Xenate ion**

S.N. = 5

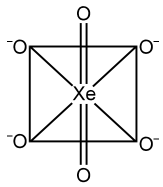
sp^3d



XeO_6^{4-} **Perxenate ion**

(No peroxide group)

Structure of $[XeO_6]^{4-}$



44. Select the incorrect ....

Sol. Distance between two nearest tetrahedral void is $\dfrac{a}{2}$

45. Which one of the following ....

Sol. (3) Carbonate ores are calcined in absence of air to obtain the metal oxides.

46. The gas escaping from ....

Sol.

	O_2
$2CO + O_2 \longrightarrow 2CO_2$	14
$2H_2 + O_2 \longrightarrow 2H_2O$	1.5
$CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$	1. 2
$C_2H_4 + 3O_2 \longrightarrow 2CO_2 + 2H_2O$	0.6
	17.3 Parts × 5 = 86.5 part of the air

200 m^3 of the gas 2× 86.5 = 173 m^3 Ans.

47. Find total number of ....

Sol. Two geometrical isomer (cis and trans) and two linkage isomer (–SCN and –CNS).

48. A solid compound 'X' ....

Sol. The given compound X must be $CaCO_3$. It can be explained by following reactions,

$\underset{(X)}{CaCO_3} \xrightarrow{\Delta} \underset{Residue}{CaO} + CO_2\uparrow ; CaO + H_2O \rightarrow \underset{(Y)}{Ca(OH)_2}$

$Ca(OH)_2 + CO_2 + H_2O \longrightarrow \underset{Z}{Ca(HCO_3)}$

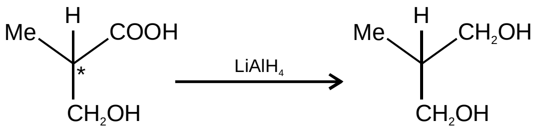
$Ca(HCO_3)_2 \xrightarrow{\Delta} \underset{(X)}{CaCO_3} + CO_2\uparrow + H_2O$

49. In which of the following ....

Sol. Maltose has hemi acetal linkage so it can reduce tollen's reagent and all mono saccharides (e.g. Fructose, Glucose, Ribose, Mannose ….) give tollen's test but polysaccharides (Cellulose, Starch, Amylopectin.......) do not give tollen's test.

50. Compound (A) ($C_4H_8O_3$) ....

Sol. $NaHCO_3$ test shows the presence of the (–COOH) group, and from the structures given in the problem, only the compound in (a) on reduction with $LiAlH_4$ gives achiral product.

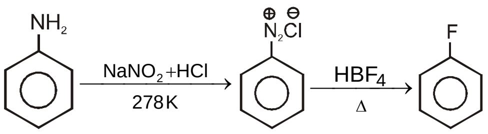


Chiral Achiral

The compounds (2), (3) and (4) with $LiAlH_4$ will give chiral products. So the answer is (1).

51. In the chemical reactions ....

Sol.

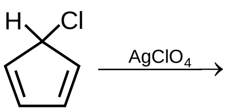


52. Which reagent is not ....

Sol. Fehling solution does not oxidise aromatic aldehydes.

53. Which of the following ....

Sol.



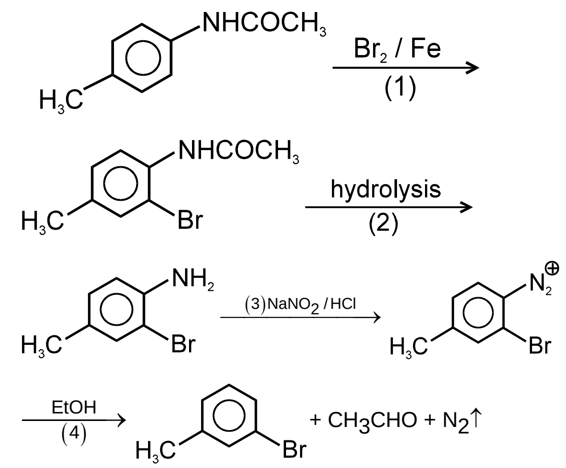
After removal of Cl-atom, formed intermediate is anti-aromatic so this reaction is not possible.

54. How many structures ....

Sol. Primary amines give carbyl amine test. Total 4 primary amines structures are possible with $C_4H_{11}N$.

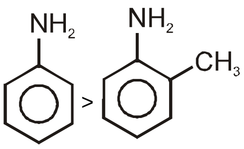
55. The end product of following ....

Sol.



56. Select the incorrect ....

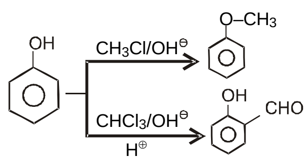
Sol. Basic-strength :



(due to ortho effect)

57. In the following ………

Sol.

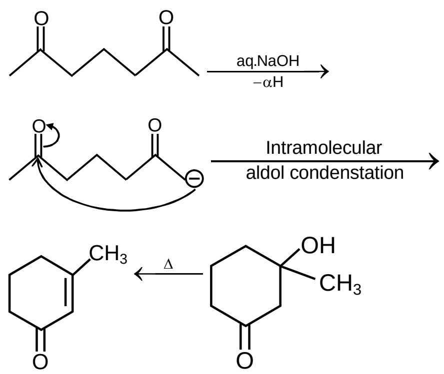


(williamson's ether synthesis)

(Reimer Tiemann Reaction)

58. Which of the following ....

Sol.



60. Which of the following ....

Sol. Ascorbic acid is one form of vitamin C

PART-C : MATHEMATICS

61. Let p : Sindhu ....

Sol. $\sim(\sim q \wedge p) = (\sim(\sim q)) \vee (\sim p)$

$= \sim p \vee q$

$= p \to q$

$\therefore$ contrapositive is $\sim q \to \sim p$

62. The mean marks........................

Sol. n + m = 120 .... (1)

$56 = \frac{50n + 60m}{120}$ .... (2)

(1) & (2) $\to$ n = 48 & m = 72

$\therefore \frac{9n}{m} = 6$

63. U_1, U_2, ..., U_{15} ....

Sol. Let $|U_1 U ... U U_{15}| = m$

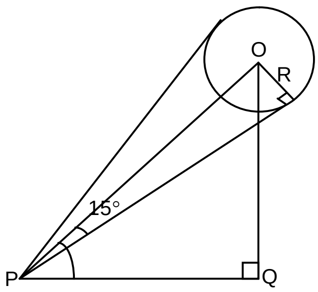
Then $\sum_{i=1}^{15} |U_i| = 3m$

$\Rightarrow$ 30 = 3m $\Rightarrow$ m = 10

$4 \times 10 = 10 \times n \Rightarrow$ n = 4

64. A spherical ....

Sol.



OP = R cosec ($15°$)

OP sin($60°$) = 6

R cosec ($15°$) sin ($60°$) =6

65. X is a binomial ....

Sol. $Var(X) = npq$

pq max = $\frac{1}{4}$

67. Let α, β be ....

Sol. Let y = $(\alpha + \beta) - \sqrt{\alpha^2 + \beta^2}$

y = $-\sqrt{2} - \sqrt{4}$

$y + \sqrt{2} = -2$

$y^2 + 2\sqrt{2}y - 2 = 0$

68. $\frac{3 + \cot(76^0).\cot(16^0)}{\cot(76^0) + \cot(16^0)}$........................

Sol. Changing into sines & cosines, the expression simplifies to $\cot(44°)$.

69. AD is altitude of........................

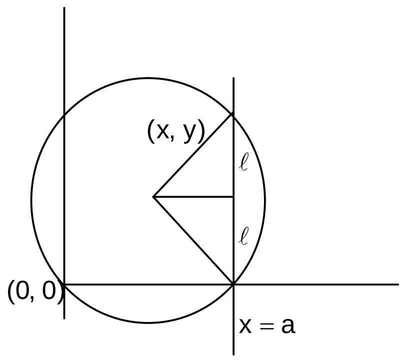
Sol. Let $\angle BAD = A_1$ & $\angle CAD = A_2$,

Then $\tan A_1 = 1/3$, $\tan A_2 = 1/2$

$A = A_1 + A_2 = 45^0$.

70. A circle passes ....

Sol.



$(a - x_1)^2 + \ell^2 = x_1^2 + y_1^2$

Locus $y^2 = a^2 + \ell^2 - 2ax$

71. If f(x) is a 4[th] ....

Sol. (x+1) $f(x) - x = \lambda x(x-1)(x-2)(x-3)(x-4)$

Put $x = -1, \lambda = -\frac{1}{120}$

Put x = 5

$6f(5) - 5 = \frac{-1}{120} \times 120$

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

73. Let $f'(x) = \frac{x^2}{1 + x^5} \; \forall \, x$ ....

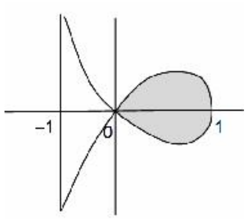
Sol. Applying LMVT in [1 ,2]

for some c in (1 , 2), we have $\frac{f(2) - f(1)}{2 - 1} = f'(c)$

Also, $\frac{4}{33} < \frac{c^2}{1 + c^5} < \frac{1}{2} \Rightarrow \frac{4}{33} < f(2) < \frac{1}{2}$

74. Area bounded ....

Sol.



Shaded area $= 2\int_0^1 x\sqrt{\frac{1-x}{1+x}}\,dx$

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

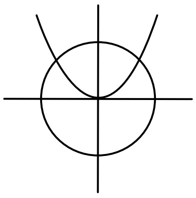
75. A is a 3 × 3 ....

Sol. By construction

76. Let R_1 = {(x, y) ....

Sol. R_1 is interior of circle $x^2 + y^2 = 5^2$

R_2 is interior of parabola $x^2 = \frac{9}{4}y$



$R_1 \cap R_2 = \{(x, y) : -3 \le x \le 3, 0 \le y \le 5\}$

Domain = [–3, 3] Range = [0, 5]

$(0, y) \in R_1 \cap R_2$ where $0 \le y \le 5$

$(0, 0) \in R_1 \cap R_2$

$(0, 1) \in R_1 \cap R_2$

$(0, 3) \in R_1 \cap R_2$

Hence not a function

77. If $\alpha + \beta + \gamma = \frac{\pi}{2}$ ....

Sol. $\begin{vmatrix} \cos(\alpha+\beta+\gamma) & \sin\beta & -\cos\gamma \\ -\sin\beta & \sin(2\alpha+2\beta+2\gamma) & \tan\alpha \\ \sin(\alpha+\beta) & -\tan\alpha & \cot(\alpha+\beta+\gamma) \end{vmatrix}$

$= \begin{vmatrix} 0 & \sin\beta & -\cos\gamma \\ -\sin\beta & 0 & \tan\alpha \\ \cos\gamma & -\tan\alpha & 0 \end{vmatrix} = 0$

78. Let p and q ....

Sol. $p + q = \frac{m-2}{m}$ $\quad pq = \frac{3}{m}$

$\frac{p}{q} + \frac{q}{p} = \frac{2}{3} \Rightarrow 3(p^2 + q^2) = 2pq$

$\Rightarrow 3((p+q)^2 - 2pq) = \frac{6}{m}$

$3\left(\frac{m-2}{m}\right)^2 - \frac{18}{m} = \frac{6}{m}$

$\Rightarrow (m-2)^2 = 8m$

$\Rightarrow m^2 - 12m + 4 = 0$

$m_1 + m_2 = 12 \quad m_1m_2 = 4$

$\frac{m_1}{m_2^2} + \frac{m_2}{m_1^2} = \frac{m_1^3 + m_2^3}{(m_1m_1)^2}$

$= \frac{(m_1+m_2)^3 - 3m_1m_2(m_1+m_2)}{(m_1m_2)^2} = 99$

79. A straight line ....

Sol. $y = x \Rightarrow x = \frac{r}{\sqrt{2}}, y = \frac{r}{\sqrt{2}} \Rightarrow P\left(\frac{r}{\sqrt{2}}, \frac{r}{\sqrt{2}}\right)$

$\frac{3r}{\sqrt{2}} - \frac{4r}{\sqrt{2}} = 6 \quad \Rightarrow \quad r = -6\sqrt{2} = OP$

$Q\left(\frac{r}{\sqrt{2}}, \frac{r}{\sqrt{2}}\right) \quad \frac{6r}{\sqrt{2}} - \frac{8r}{\sqrt{2}} + c = 0$

$r = \frac{c}{\sqrt{2}} \Rightarrow Q$

$3(6\sqrt{2}) = 4\left|\frac{c}{\sqrt{2}}\right| \Rightarrow \quad c = \pm 9$

80. If m & M are ....

Sol. $M = |2\vec{a}|^2 + |2\vec{b}|^2 + |2\vec{c}|^2 = 12$

when $\vec{a}, \vec{b}, \vec{c}$ are parallel $|\vec{a}+\vec{b}+\vec{c}|^2 \ge 0$

$|\vec{a}|^2 + |\vec{b}|^2 + |\vec{c}|^2 + 2(\vec{a}.\vec{b} + \vec{b}.\vec{c} + \vec{c}.\vec{a}) \ge 0$

$\vec{a}.\vec{b} + \vec{b}.\vec{c} + \vec{c}.\vec{a} \ge -\frac{3}{2}$

$|\vec{a}+\vec{b}|^2 + |\vec{b}+\vec{c}|^2 + |\vec{c}+\vec{a}|^2$

$= 2(|\vec{a}|^2 + |\vec{b}|^2 + |\vec{c}|^2$

$+\vec{a}.\vec{b} + \vec{b}.\vec{c} + \vec{c}.\vec{a}) \ge 2\left(3 - \frac{3}{2}\right) \ge 3$

81. Let $a = \cos^{-1}(\cos 20)$ ....

Sol. By graph $a = 20 - 6\pi$,

$b = 10\pi - 30$,

$c = \sin^{-1}(\sin(4\pi - 10)) = 10 - 3\pi$

$\Rightarrow a + b + c = \pi$

G.E = $\sin(2(\pi)x) + \cos^2((\pi)x)$

$= \frac{1}{2} + \frac{1}{2}\cos(2\pi x) + \sin(2\pi x)$

Maximum value

$= \frac{1}{2} + \sqrt{\frac{1}{4}+1} = \frac{1}{2} + \frac{\sqrt{5}}{2} = \frac{\sqrt{5}+1}{2}$

82. If C is arbitartry ....

Sol. Divide numerator and denominator by x^2

$\int \frac{\frac{2}{x^2} + \frac{\sqrt{x}}{x^2}}{\left(1 + \frac{1}{\sqrt{x}} + \frac{1}{x^2}\right)^2} dx$

put $t = 1 + \frac{1}{\sqrt{x}} + \frac{1}{x}$ $\quad dt = \left(-\frac{1}{2x\sqrt{x}} - \frac{1}{x^2}\right)dx$

$= -2\int \frac{dt}{t^2} = \frac{2}{t} + C = \frac{2x}{x + \sqrt{x} + 1} + C$

83. Let $\hat{a}, \hat{b}, \hat{c}$ be........................

Sol. $\hat{a}, \hat{b}, \hat{c}$ will form an equilateral triangle

$|x\hat{a} + y\hat{b} + z\hat{c}|^2 = x^2 + y^2 + z^2 - xy - yz - zx$

$= \frac{1}{2}[(x-y)^2 + (y-z)^2 + (z-x)^2] = \frac{1}{2}[1 + 1 + 4] = 3$

84. If the number ....

Sol. Out of numbers $\frac{1}{2}, \frac{2}{4}, \frac{3}{6}, \frac{1}{3}, \frac{2}{6}, \frac{2}{3}, \frac{4}{6}$ will result in only 3 distinct rational numbers.

$\Rightarrow$ Total numbers $= {}^6C_2 - 4 = 11$

85. If A, B are events........................

Sol. (A) $P(A \cup B) \geq \max\{P(A), P(B)\} = \frac{2}{3}$

(B) $P(A \cap B) = P(A) + P(B) - P(A \cup B) \geq P(A) + P(B) - 1$

$= \frac{3}{5} + \frac{2}{3} - 1 = \frac{4}{15}$

$P(A \cap B) \leq \min.\{P(A), P(B)\} = \frac{3}{5}$

(C) $P\left(\frac{A}{B}\right) = \frac{P(A \cap B)}{P(B)}$

$\therefore \frac{4}{15} \leq P(A \cap B) \leq \frac{3}{5}$

$\Rightarrow \frac{4}{15P(B)} \leq \frac{P(A \cap B)}{P(B)} \leq \frac{3}{15P(B)}$

$\Rightarrow \leq \frac{2}{5} P\left(\frac{A}{B}\right) \leq \frac{9}{10}$

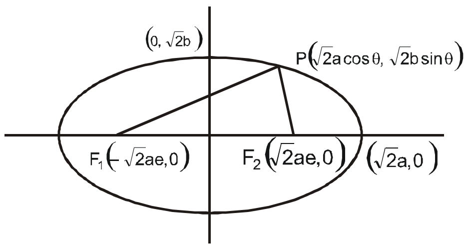
(D) $P(A \cap \bar{B}) = P(A) - P(A \cap B)$

$\Rightarrow \frac{3}{5} - \frac{3}{5} \leq P(A \cap \bar{B}) \leq \frac{3}{5} - \frac{4}{15}$

$\Rightarrow P(A \cap \bar{B}) \leq \frac{1}{3}$

86. P is a variable ....

Sol.



area of $\Delta PF_1F_2 = A = \frac{1}{2}(2\sqrt{2}ae)\ \sqrt{2}\,b\sin\theta$

$\Rightarrow A = 2abe\sin\theta$

Maximum area $A = 2abe$

$= \frac{2ab}{a}\ \sqrt{a^2 - b^2} = 2b\ \sqrt{a^2 - b^2}$

87. Two parabolas ....

Sol. Parabola open upward and to the right

Let intersection point are P & Q

PA $\perp$ to x-axis to perpendicular

PB $\perp$ to y- axis to perpendicular

PA = PB = PS

$\Rightarrow$ P lies on y = x

88. $\int_2^4 \frac{\sqrt{\ell n\ (81 - 18x + x^2)}}{\sqrt{\ell n\ (81 - 18x + x^2)} + \sqrt{\ell n\ (x^2 + 6x + 9)}}$ ....

Sol. Let $I = \int_2^4 \frac{\sqrt{\ell n\ (x-9)^2}}{\sqrt{\ell n\ (x-9)^2} + \sqrt{\ell n\ (x+3)^2}}\, dx$ ....(i)

[by property $\int_a^b f(x)\ dx = \int_a^b f(a+b-x)\ dx$]

$x \to 6 - x$

$I = \int_2^4 \frac{\sqrt{\ell n\ (x+3)^2}}{\sqrt{\ell n\ (x+3)^2} + \sqrt{\ell n\ (9-x)^2}}\, dx$ ....(ii)

Adding (i) & (ii)

$2I = \int_2^4 1\, dx = 2 \Rightarrow I = 1$

89. Let f : $(0, \infty) \to R$ ....

Sol. $\because F(x^2) = \int_0^{x^2} t f(t) dt = x^4 + x^5$

$\Rightarrow x^2 f(x^2).2x = 4x^3 + 5x^4$

$\therefore f(x^2) = \frac{5}{2}x + 2$

$\therefore \sum_{r=1}^{12} f(r^2) = \sum_{r=1}^{12}\left(\frac{5}{2}r + 2\right)$

$= \frac{5}{2} \times \frac{12 \times 13}{2} + 2\times12 = 219$

90. The value of ....

Sol. $f(x) = \sin x - \cos x - ax + b$

$f'(x) = \cos x + \sin x - a$

$\Rightarrow \left(\sin\left(x + \frac{\pi}{4}\right)\right) - a$

$-1 \leq \sin\left(x + \frac{\pi}{4}\right) \leq 1$

$-\sqrt{2} < \sqrt{2}\ \sin\left(x + \frac{\pi}{4}\right) \leq \sqrt{2}$

so, to make $f'(x)$ always negative or equal to zero

$a \geq \sqrt{2}$

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(JEE MAIN PATTERN)
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DATE : 28-01-2018

COURSE : VIJETA (01JP, 02JP), VIJAY (01JR, 07JR), VISHWAAS (01JF), ANOOP (01EP), AJAY (01ER, 07ER), AKHIL (01EF), VIVEK (JCC)

ANSWER KEY

CODE-0

PHYSICS

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

CHEMISTRY

31.	(1)	**32.**	(1)	**33.**	(3)	**34.**	(2)	**35.**	(2)	**36.**	(3)	**37.**	(2)
38.	(1)	**39.**	(4)	**40.**	(4)	**41.**	(3)	**42.**	(4)	**43.**	(3)	**44.**	(3)
45.	(3)	**46.**	(2)	**47.**	(3)	**48.**	(4)	**49.**	(2)	**50.**	(1)	**51.**	(3)
52.	(2)	**53.**	(4)	**54.**	(1)	**55.**	(4)	**56.**	(4)	**57.**	(2)	**58.**	(3)
59.	(1)	**60.**	(2)										

MATHEMATICS

61.	(4)	**62.**	(4)	**63.**	(4)	**64.**	(4)	**65.**	(3)	**66.**	(3)	**67.**	(1)
68.	(1)	**69.**	(2)	**70.**	(3)	**71.**	(4)	**72.**	(1)	**73.**	(1)	**74.**	(3)
75.	(2)	**76.**	(4)	**77.**	(4)	**78.**	(3)	**79.**	(4)	**80.**	(2)	**81.**	(1)
82.	(2)	**83.**	(4)	**84.**	(1)	**85.**	(3)	**86.**	(2)	**87.**	(1)	**88.**	(2)
89.	(4)	**90.**	(1)										

CODE-1

PHYSICS

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

CHEMISTRY

31.	(2)	**32.**	(2)	**33.**	(3)	**34.**	(3)	**35.**	(3)	**36.**	(3)	**37.**	(3)
38.	(2)	**39.**	(3)	**40.**	(4)	**41.**	(2)	**42.**	(4)	**43.**	(4)	**44.**	(3)
45.	(4)	**46.**	(1)	**47.**	(4)	**48.**	(4)	**49.**	(3)	**50.**	(1)	**51.**	(4)
52.	(3)	**53.**	(4)	**54.**	(2)	**55.**	(3)	**56.**	(4)	**57.**	(3)	**58.**	(2)
59.	(2)	**60.**	(3)										

MATHEMATICS

61.	(4)	**62.**	(3)	**63.**	(3)	**64.**	(3)	**65.**	(4)	**66.**	(4)	**67.**	(2)
68.	(2)	**69.**	(3)	**70.**	(4)	**71.**	(3)	**72.**	(2)	**73.**	(2)	**74.**	(4)
75.	(3)	**76.**	(3)	**77.**	(4)	**78.**	(4)	**79.**	(3)	**80.**	(3)	**81.**	(1)
82.	(2)	**83.**	(4)	**84.**	(3)	**85.**	(3)	**86.**	(4)	**87.**	(3)	**88.**	(2)
89.	(4)	**90.**	(3)										

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ANSWER KEY

CODE-2

PHYSICS

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

CHEMISTRY

31.	(1)	**32.**	(1)	**33.**	(3)	**34.**	(2)	**35.**	(2)	**36.**	(3)	**37.**	(2)
38.	(1)	**39.**	(4)	**40.**	(4)	**41.**	(3)	**42.**	(4)	**43.**	(3)	**44.**	(3)
45.	(3)	**46.**	(2)	**47.**	(3)	**48.**	(4)	**49.**	(2)	**50.**	(1)	**51.**	(3)
52.	(2)	**53.**	(4)	**54.**	(1)	**55.**	(4)	**56.**	(4)	**57.**	(2)	**58.**	(3)
59.	(1)	**60.**	(2)										

MATHEMATICS

61.	(4)	**62.**	(4)	**63.**	(4)	**64.**	(4)	**65.**	(3)	**66.**	(3)	**67.**	(1)
68.	(1)	**69.**	(2)	**70.**	(3)	**71.**	(4)	**72.**	(1)	**73.**	(1)	**74.**	(3)
75.	(2)	**76.**	(4)	**77.**	(4)	**78.**	(3)	**79.**	(4)	**80.**	(2)	**81.**	(1)
82.	(2)	**83.**	(4)	**84.**	(1)	**85.**	(3)	**86.**	(2)	**87.**	(1)	**88.**	(2)
89.	(4)	**90.**	(1)										

CODE-3

PHYSICS

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

CHEMISTRY

31.	(2)	**32.**	(2)	**33.**	(3)	**34.**	(3)	**35.**	(3)	**36.**	(3)	**37.**	(3)
38.	(2)	**39.**	(3)	**40.**	(4)	**41.**	(2)	**42.**	(4)	**43.**	(4)	**44.**	(3)
45.	(4)	**46.**	(1)	**47.**	(4)	**48.**	(4)	**49.**	(3)	**50.**	(1)	**51.**	(4)
52.	(3)	**53.**	(4)	**54.**	(2)	**55.**	(3)	**56.**	(4)	**57.**	(3)	**58.**	(2)
59.	(2)	**60.**	(3)										

MATHEMATICS

61.	(4)	**62.**	(3)	**63.**	(3)	**64.**	(3)	**65.**	(4)	**66.**	(4)	**67.**	(2)
68.	(2)	**69.**	(3)	**70.**	(4)	**71.**	(3)	**72.**	(2)	**73.**	(2)	**74.**	(4)
75.	(3)	**76.**	(3)	**77.**	(4)	**78.**	(4)	**79.**	(3)	**80.**	(3)	**81.**	(1)
82.	(2)	**83.**	(4)	**84.**	(3)	**85.**	(3)	**86.**	(4)	**87.**	(3)	**88.**	(2)
89.	(4)	**90.**	(3)										