



Date : 10-04-2015

ANSWER KEY

JEE-MAIN ONLINE - 2015

PHYSICS

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

CHEMISTRY

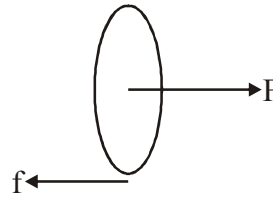
1.	[1]	2.	[3]	3.	[1]	4.	[3]
5.	[1]	6.	[3]	7.	[3]	8.	[4]
9.	[3]	10.	[2]	11.	[3]	12.	[4]
13.	[2]	14.	[2]	15.	[3]	16.	[3]
17.	[2]	18.	[1]	19.	[1]	20.	[2]
21.	[4]	22.	[4]	23.	[4]	24.	[1]
25.	[3]	26.	[3]	27.	[3]	28.	[3]
29.	[1]	30.	[4]				

MATHEMATICS

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

PHYSICS

1. $F - f = ma$
 and $fR = I\alpha$
 for Rolling $a = \alpha R$
 $F - f = ma \dots \dots (i)$



$$fR = \frac{mR^2}{2} \cdot \frac{a}{R}$$

$$f = \frac{ma}{2} \dots \dots (ii)$$

so, $f - \frac{ma}{2} = ma$

$$f = \frac{3}{2}ma$$

2. $I_1 = 5A$
 $I_2 = 2A$
 $\Delta I = 2 - 5 = -3A$
 $\Delta t = 0.1 \text{ sec}$
 Emf = 50v

$$emf = \varepsilon = -L \frac{di}{dt}$$

$$50 = -L \left(\frac{-3}{0.1} \right)$$

$$50 = 30L$$

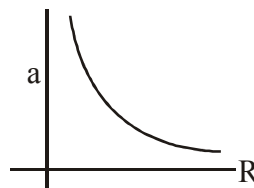
$$L = \frac{5}{3} = 1.67H$$

3. speed $v = 10 \text{ m/sec}$

$$a = \frac{v^2}{R}$$

$$|\vec{v}| = \text{constant}$$

so $a \propto \frac{1}{R}$



4. Emwave

$$f = 2 \times 10^{14} \text{ Hz}$$

$$E_0 = 27 \text{ V/m}$$

we know $\rightarrow \frac{E}{B} = C$

$$\text{so } B = \frac{27}{3 \times 10^8} = 9 \times 10^{-8} \text{ T}$$

$$\text{now for } \lambda = \frac{3 \times 10^8}{2 \times 10^{14}} = 1.5 \times 10^{-6} \text{ m}$$

$$\text{so } B = 9 \times 10^{-8} \sin \left(2\pi \left[\left(\frac{1}{1.5 \times 10^{-6}} \right) x - 2 \times 10^{14} t \right] \right) \hat{k}$$

5. $F = \left(\frac{k}{r} \right) m$

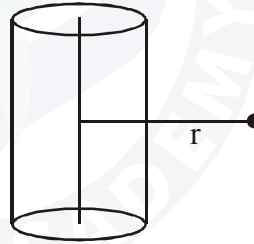
k is some constant

$$\text{so } \frac{mv^2}{r} = \frac{km}{r} \Rightarrow v = \text{constant}$$

$$T = \frac{2\pi r}{v}$$

$$T \propto r$$

straight line



6. Time = 5 min = 300 sec.

$$\text{Volume} = 15 \text{ ltr.} = 15 \times 10^{-3} \text{ m}^3$$

$$\text{Diameter} = \frac{2}{\sqrt{\pi}} \text{ cm}$$

$$\text{Area of tap} = \pi \left(\frac{1}{\sqrt{\pi}} \times 10^{-2} \right)^2 = 10^{-4} \text{ M}^2$$

$$\text{Velocity of water} = \frac{V}{At} = \frac{15 \times 10^{-3}}{1 \times 10^{-4} \times 300} = \frac{1}{2} \text{ m/sec}$$

$$R_w = \frac{\rho V d}{\eta}$$

$$= 5649 = 5500$$

7. For cylindrical

$$\Delta P = \frac{T}{R}$$

no option

8.
$$\int \vec{dE} = \int \frac{Kh\sigma 2\pi x dx}{(h^2 + x^2)^{3/2}}$$

$$E = \sigma Kh2\pi \int \frac{x dx}{(h^2 + x^2)^{3/2}} \dots\dots\dots(i)$$

$$I = \int \frac{x dx}{(h^2 + x^2)^{3/2}}$$

$$x = h \tan \theta$$

$$dx = h \sec^2 \theta d\theta$$

$$I = \int \frac{h \tan \theta \times h \sec^2 \theta d\theta}{h^3 \sec^3 \theta}$$

$$= \int \frac{1}{h} \sin \theta d\theta$$

$$= -\frac{\cos \theta}{h}$$

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

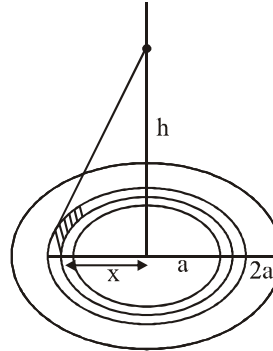
Put it in equation (i)

$$E = \frac{\sigma h}{2\epsilon_0} \left[-\frac{1}{\sqrt{x^2 + h^2}} \right]_{x=a}^{x=2a}$$

$$= \frac{\sigma h}{2\epsilon_0} \left[\frac{1}{a} - \frac{1}{2a} \right]$$

$$E = \frac{\sigma h}{4\epsilon_0 a} = ch$$

$$\Rightarrow C = \frac{\sigma}{4\epsilon_0 A}$$



9. $C = e^x a_0^y h^z c^a$

Capacitance $C = [M^{-1}L^{-2}A^2T^4]$

$e = [AT]$ $a_0 = [L]$

$c = [LT^{-1}]$

$h = [M^1L^2T^{-1}]$

$[M^{-1}L^{-2}A^2T^4] = [AT]^x [L]^y [M^1L^2T^{-1}]^z [LT^{-1}]^a$

Compare $x = 2$

$z = -1$

$\frac{M^{-1}L^{-2}A^2T^4}{A^2T^2M^{-1}L^{-2}T^1} = [L]^y [LT^{-1}]^a$

$T = [L^y][LT^{-1}]^a$

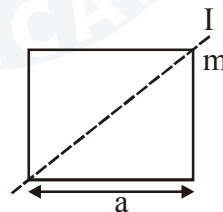
So $u = \frac{e^2 a_0}{hc}$

$\Rightarrow a = -1$

$\Rightarrow y = 1$

10. Using perpendicular axis theorem.

$I = \frac{Ma^2}{12}$



11. angular magnification on $m = \frac{f_0}{f_e} = \frac{150}{5} = 30$

so, $\frac{\tan \beta}{\tan \alpha} = 30$

$\tan \beta = \tan \alpha \times 30 = \left(\frac{50}{1000}\right) \times 30$

$= \frac{15}{10} = \frac{3}{2}$

$\beta \approx 60^\circ$

12. $V_d \propto \sqrt{E}$

$I = neAV_d$

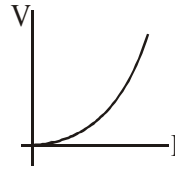
and $E = \frac{V}{l}$

so $E \propto V$

and $I \propto V_d$

so $I \propto \sqrt{V}$

$I^2 \propto V$



13. Electron concentration in n-region is more as compared to that in p-region.

14. $x \propto \sin t - \frac{1}{2} \sin 2t$

at $t = 0$ x & velocity both has to be zero

15. $(P_y)d \gg h$

to go straight otherwise diffraction will occur

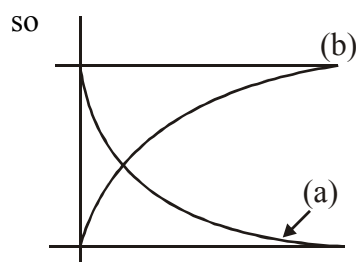
16. Circuit

a —

$i = i_0 e^{-t/RC}$

for b

$i = i_0 (1 - e^{-t/L/R})$



17. Energy of proton = $\frac{1}{2}mv^2 = qV$

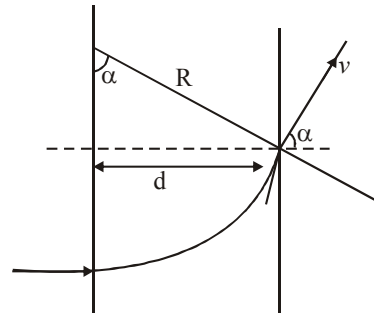
$$v = \sqrt{\frac{2qV}{m}}$$

magnetic force = $q(\vec{v} \times \vec{B}) = \frac{mv^2}{R}$

$$R = \frac{mv}{qB}$$

$$\sin \alpha = \frac{d}{R} = \frac{dqB}{mv} = \frac{dqB}{m} \sqrt{\frac{m}{2qV}}$$

$$\sin \alpha = Bd \sqrt{\frac{q}{2mV}}$$



18. momentum $P = \sqrt{2mE}$ and $E = eV$

$$\lambda = \frac{h}{p} = \frac{h}{\sqrt{2mE}}$$

$$= \frac{6.6 \times 10^{-34}}{\sqrt{2 \times 9.1 \times 10^{-31} \times 1.6 \times 10^{-19} \times 50}}$$

$$= 1.7 \times 10^{-10} \text{ M}$$

$$= 1.7 \text{ \AA}$$

19. $\bar{x} = \frac{x_1 + x_2 + x_3}{3}$

$$= \frac{0.58 + 0.54 + 0.56}{3}$$

$$\bar{x} = 0.56$$

so value = 0.56 + error

$$= 0.56 + 0.03$$

$$= 0.59 \text{ cm}$$

20. $mvR = \frac{nh}{2\pi} \dots (i)$

and $qvB = \frac{mv^2}{R}$

so $qB = \frac{mv}{R} \dots (ii)$

$qB \left(\frac{nh}{2\pi mv} \right) = mv$

$mv^2 = \frac{qBnh}{2\pi m}$

$\frac{1}{2}mv^2 = \frac{1}{4\pi m}nhqB$

$E = n \left(\frac{hqB}{4\pi m} \right)$

21. $x = a \sin wt$

$y = a \sin 2wt$

$y = 2a \sin wt \cos wt$

$y = 2x \sqrt{1 - \frac{x^2}{a^2}}$

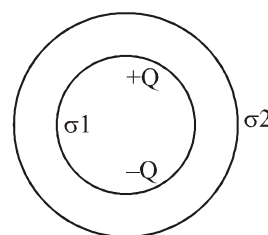
$y = \frac{2}{a} x \sqrt{(a-x)(a+x)}$

22. On outer surface there will be no charge.

So $Q_2 = \sigma_2 = 0$

On inner surface total charge will be zero but charge distribution will be there so

$Q_1 = 0 \quad \sigma_1 \neq 0$



23. If block to come to rest after 2m.

$$\text{So, } d = \frac{u^2}{2a}$$

$$a = \mu g = 0.05 \times 10 = 0.5 \text{ m/sec}^2$$

$$u^2 = 2 \times 2 \times 0.5 = 2$$

$$u = \sqrt{2} \text{ m/sec}$$

by momentum conservation

$$\sqrt{2}(10 + 50 \times 10^{-3}) = (50 \times 10^{-3}) \times V$$

$$\text{approximately } \frac{\sqrt{2} \times 10}{50 \times 10^{-3}} = V$$

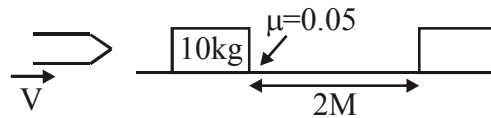
$$V = 200\sqrt{2} \text{ m/sec}$$

$$\text{so } \frac{V}{10} = 20\sqrt{2}$$

to get $V = 20\sqrt{2} \text{ m/sec}$

$$V^2 = 2gh$$

$$h = \frac{800}{20} = 40 \text{ m}$$



24. The block comes to rest means its velocity at that point was 3 m/sec.

So that point

$$K.E. = \frac{1}{2} \times mv^2$$

$$= \frac{1}{2} \times 0.1 \times (3)^2$$

$$= \frac{0.9}{2} = 0.45 \text{ J}$$

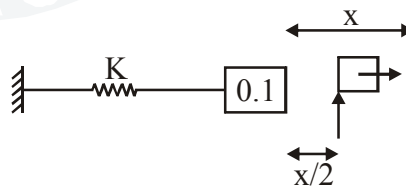
at displacement $\frac{x}{2}$

$$P.E. = \frac{1}{4} T.E.$$

$$K.E. = \frac{3}{4} T.E.$$

$$\text{So } T.E. = \frac{4}{3} \times 0.45$$

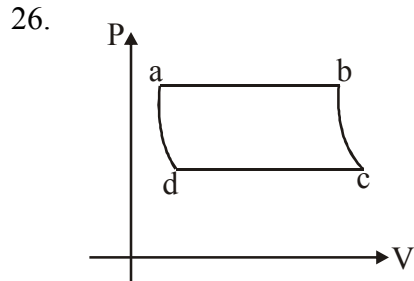
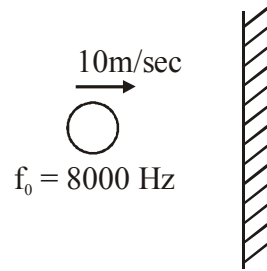
$$= 0.6 \text{ J}$$



$$25. \quad f' = \left(\frac{320+10}{320-10} \right) \times 8000$$

$$= \frac{330}{310} \times 8000$$

$$= 8516 \text{ Hz}$$



27. $l = 20 \text{ cm}$
 $r = 2 \text{ cm}$
 $N = 500 \text{ turns}$
 $i = 15 \text{ A}$

$$\vec{M} = \frac{500 \times 15 \times \pi \times (2 \times 10^{-2})^2}{\pi (2 \times 10^{-2})^2 \times 25 \times 10^{-2}}$$

$$= \frac{15 \times 500}{25 \times 10^{-2}}$$

$$= \frac{7500 \times 10^2}{25} = 30000 \text{ AM}^{-1}$$

28. $F = \frac{2mv}{t}$

$$t = \frac{2l}{v} = \frac{\text{distance}}{\text{velocity}}$$

$$t \propto \frac{1}{v}$$

$$F \propto v^2$$

and $K.E. \propto T$

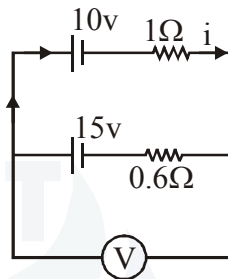
$$\frac{1}{2}mv^2 \propto T$$

$$V^2 \propto T$$

$$\Rightarrow F \propto T$$

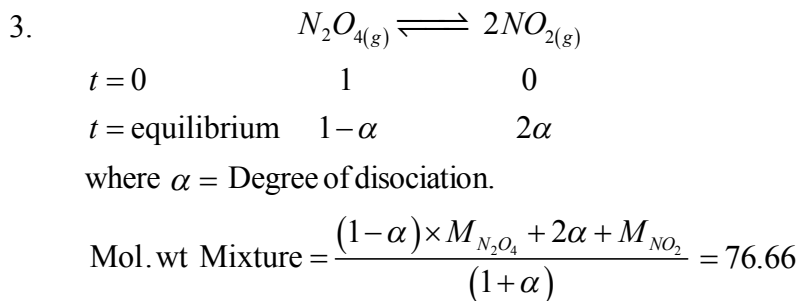
29. $u = -10\text{cm}$
 $v = +15\text{cm}$
 $f = ?$
 $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$
 $\frac{1}{15} - \frac{1}{10} = \frac{1}{f} = \frac{2}{R}$
 $-\frac{5}{150} = \frac{2}{R}$
 $R = -\frac{300}{5} = -60\text{cm}$

30. $i = \frac{5}{1.6}$
 $= \frac{50}{16} = \frac{25}{8} \text{ Amp}$
 $V = 15 - \frac{25}{8} \times 0.6$
 $= 15 - \frac{15}{8}$
 $= 13.1\text{volt}$



CHEMISTRY

1. Metal oxide calculation is the process of heating ore in absence of air
 e.g. Calcium carbonate gives $\text{CaCO}_3 \xrightarrow{\Delta} \text{CaO} + \text{CO}_2$ as calculation.
2. Only temporary hardness which is due to HCO_3^- (Bicarbonate) ions is removed by Boiling.



Now, As per Ideal gas Equation

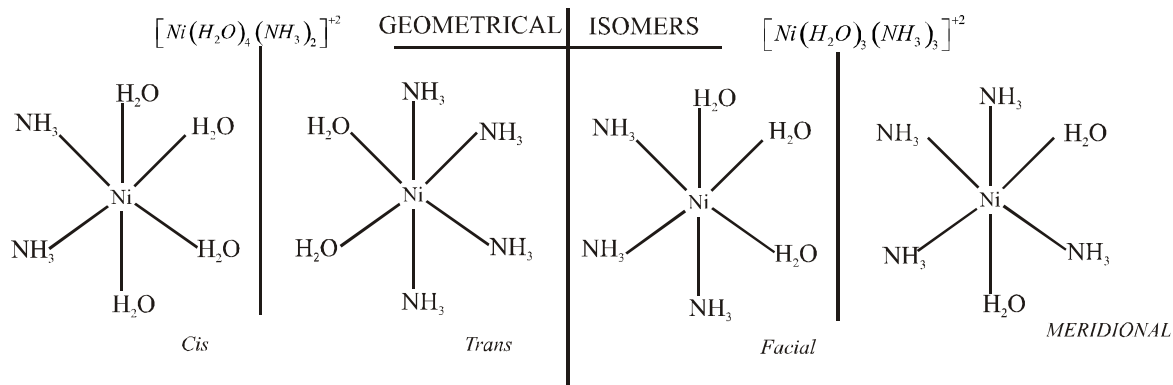
$$PV = nRT$$

$$PM_{\text{mixture}} = dRT$$

$$\therefore d = \frac{PM_{\text{mix}}}{RT} = \frac{1 \times 76.66}{0.0821 \times 300} = 3.11 \text{ g/L}$$

4. Starch is a mixture of amylose & amylopectin poly saccharides and monomer is glucose.

5. Cis $-\left[Ni(H_2O)_4(NH_3)_2 \right]^{+2}$ & facial $\left[Ni(H_2O)_3(NH_3)_3 \right]^{+2}$ have optical isomers.



6. Fluorine is the most electronegative element & has least tendency to form double bonds.

7. Mili equivalents of $H_2SO_4 = 60 \times \frac{M \times 2}{10} = 12$

Mili equivalents of NaOH = $20 \times \frac{M}{10} = 2$

Mili equivalents of $NH_3 = 12 - 2 = 10$

% of Nitrogen = $\frac{1.4 \times (N \times V) NH_3}{W}$

$$= \frac{1.4 \times 10}{1.4} = 10$$

8. Drugs which relieve pain is called analgesics.

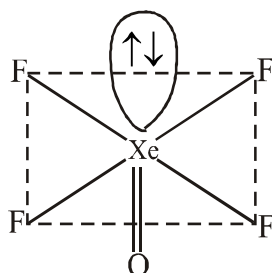
Non-narcotics :- aspirin (acetyl salicylic acid)

paracetamol (parahydrous acetanilide)

9. In $XeOF_4$, Xe is sp^3d^2 , hybridised having 5 Bond pairs & 1 lone pair

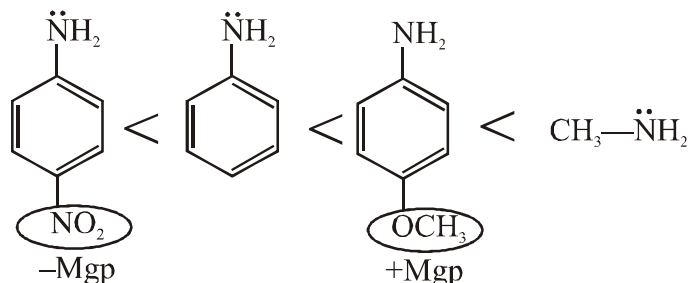
SHAPE:

Square Pyramidal



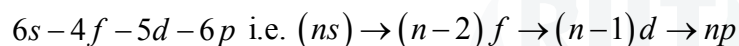
10. Basicity \propto +M group

$$\propto \frac{1}{-M \text{ group}}$$

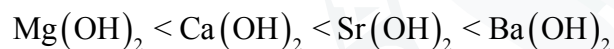


(L.P is not involved in conjugation \therefore it is more basic)

11. The sequence of filling electrons in sixth period :



12. (Thermal stability of \propto Ionic character hydroxides) or Lattice energy



13. Weight of Hydrated $\text{BaCl}_2 = 61 \text{ g}$

Weight of Anhydrous $\text{BaCl}_2 = 52 \text{ g}$

Loss in mass = 9g

Assuming $\text{BaCl}_2 \cdot x\text{H}_2\text{O}$ as hydrate

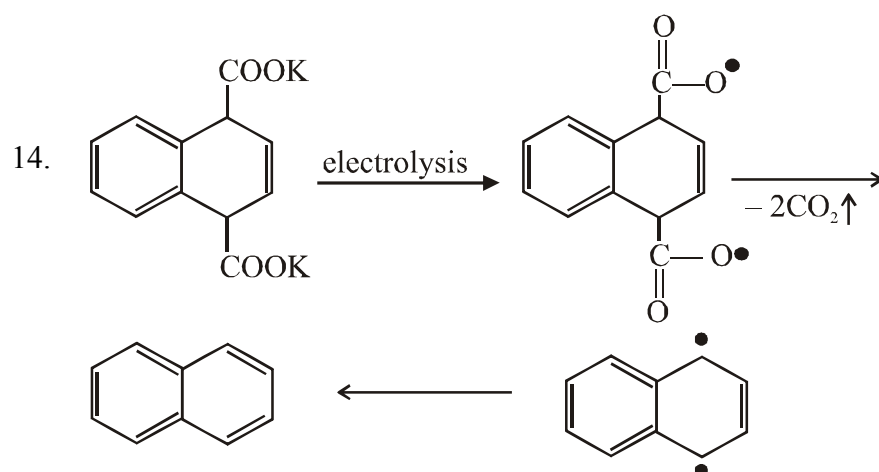
Mass of $\text{H}_2\text{O} = 9 \text{ g}$

$$\text{Moles of } \text{H}_2\text{O} = \frac{9}{18} = 0.5$$

Gross molecular let of $\text{BaCl}_2 = 208$

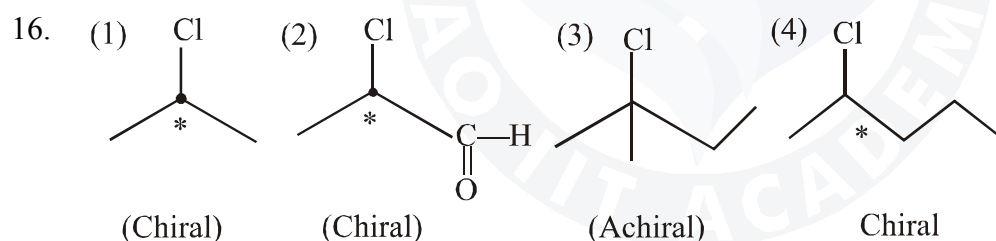
$$\% \text{ of } \text{H}_2\text{O} \text{ in this hydrated } \text{BaCl}_2 = \frac{9}{61} \times 100 = 14.75\% = \frac{18x}{208+18x} \times 100 \text{ on solving } x = 2$$

This percentage is present in $\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$



Stable due to aromatic

15. Polymer	Use
Polystyrene	Manufacture of toys
Glyptal	Paints and lacquars.
P.V.C	Rain Coats
Bakelite	Computer discs



17. $5s^2 5p^4$ valence shell configuration of group 16 element present in period 5.
Tellurium (Te).

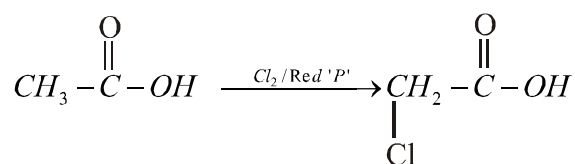
18. After adsorption there is decrease in the residual forces due to bond formation. ΔG , ΔH & ΔS all are negative in the case of adsorption,

19. EMF of galvanic cell = 1.1 volt

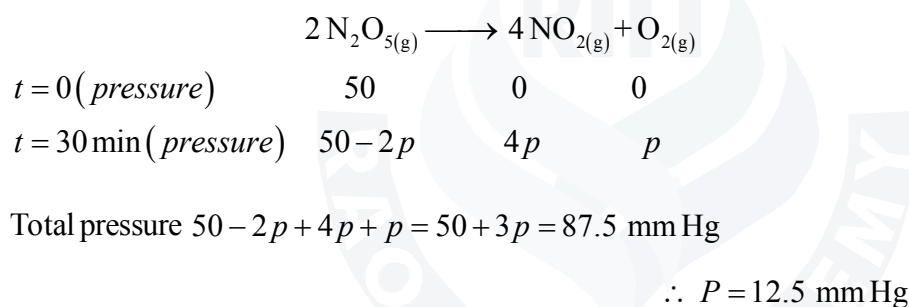
If $E_{ext} < EMF$ then electron flows steadily from anode to cathode while If $E_{ext} > EMF$ then electron flows from cathode to anode as polarity is changed.

20. Fe^{+3} , radical gives blood red with SCN^-
 Cl^- radical gives chromyl chloride Test.

21. Chemical pollutants in photo chemical smog are Nitrogen oxides (NO and NO₂), volatile organic compounds, Ozone (O₃), peroxyacetyl nitrate.
22. Hell - volhard- Zelinsky Reaction



23. CO²⁺ ion is precipitated by H₂S & NH₄OH present in group IV cationic Analysis
24. At high pressure real gas particles are easily compressed which was later gives by van-der waal's equations as per kinetic theory.
25. First order reaction rate = K[N₂O₅]



$\therefore P_0 = 50$ & $P_t = 25$ for N₂ O₅ reactant

$$\therefore K = \frac{2.303}{30 \text{ min}} \times \log\left(\frac{50}{25}\right) = \frac{2.303}{60 \text{ min}} \times \log\left(\frac{50}{x}\right)$$

On solving $x = 12.5$ mm Hg = $50 - 2p$

$\therefore P = 18.75$ mm Hg

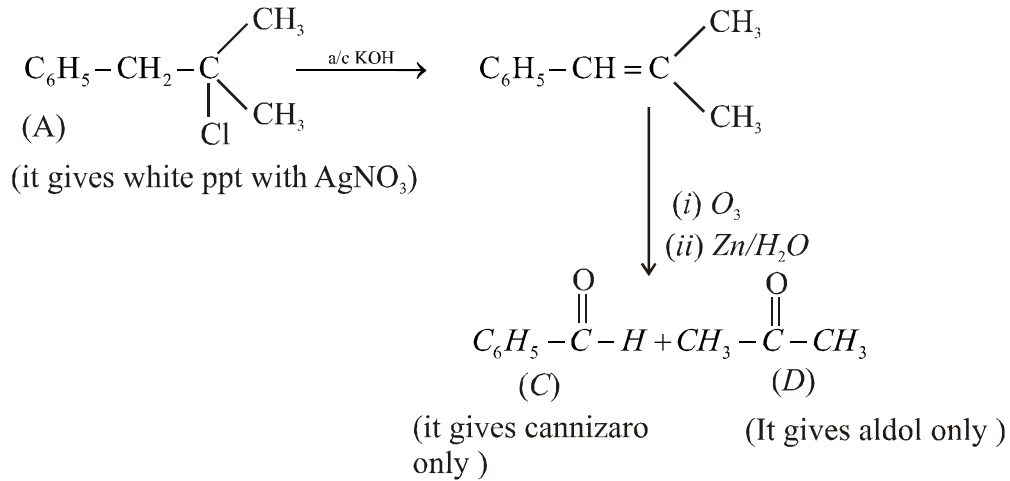
\therefore Total pressure = $50 + 3p = 106.25$ mm Hg

26. Total V.P. of solution = $P_A^0 X_A + P_B^0 X_B$

$$\begin{aligned} \text{Total V.P. of solution} &= \left(\frac{1.5}{5} \times 74.7 + \frac{3.5}{5} \times 22.3 \right) \text{ torr} \\ &= (15.6 + 22.4) \text{ torr} = 38 \text{ torr} \end{aligned}$$

$$\text{Mole fraction of Benzene in vapour form} = \frac{22.4}{38} = 0.589$$

27.



28. Ligand donates electrons to metal. In methane there is no electron to donate it is stable with octet configuration.

29. In CH_4 $4 \times BE_{(C-H)} = 360 \text{ KJ/mol} \quad \therefore BE_{(C-H)} = 90 \text{ KJ/mol}$

In C_2H_6 $BE_{(C-C)} + 6 \times BE_{(C-H)} = 620 \text{ KJ/mol}$

$$\therefore BE_{(C-C)} = 80 \text{ KJ/mol}$$

$$\therefore BE_{(C-C)} = \frac{80 \times 10^3}{6.023 \times 10^{23}} \text{ J/molecule}$$

$$\text{Now, } E = \frac{hc}{\lambda}$$

$$\therefore \lambda = \frac{6.626 \times 10^{-34} \times 3 \times 10^8 \times 6.023 \times 10^{23}}{80 \times 10^3}$$

$$\therefore \lambda = 1.49 \times 10^3 \text{ nm}$$

30. Assertion is correct but reason is Incorrect. Bonding MO involves constructive interference.

MATHEMATICS

1. Let average wage of Night shift worker is x

$$70 \times 54 + 30 \times x = 60 \times 100$$

$$x = 74$$

2. Conduction for Rolle's theorem

$$f(1) = f(-1)$$

$$\text{and } f'\left(\frac{1}{2}\right) = 0$$

$$c = -2 \text{ and } b = \frac{1}{2}$$

$$2b + c = -1$$

3. Solving

$$y + 2x^2 = 0$$

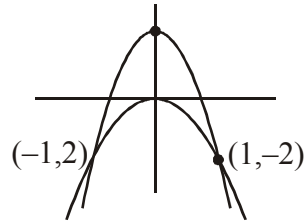
$$y + 3x^2 = 1$$

Points of intersection $(1, -2)$ and $(-1, -2)$

$$\text{Area} = 2 \int_0^1 ((1 - 3x^2) - (-2x^2)) dx$$

$$= 2 \int_0^1 (1 - x^2) dx = 2 \left(x - \frac{x^3}{3} \right)_0^1$$

$$= \frac{4}{3}$$



4. $A\left(0, \frac{8}{3}\right) B(1, 3) C(89, 30)$

$$\text{Slope of } AB = \frac{1}{3}$$

$$\text{Slope of } BC = \frac{1}{3}$$

So, lies on same line

5. Question incomplete.

$$6. \frac{(15)^2 \times (14)^2 \times \dots \times (1)^2}{15!} = 15!$$

Hence, Option is not matching.

$$7. |3 + 4 - 12\lambda + 13| = |-9 + 0 - 12 + 13|$$

$$|-12\lambda + 20| = |8|$$

$$|3\lambda - 5| = 2$$

$$9\lambda^2 + 25 - 30\lambda = 4$$

$$9\lambda^2 - 30\lambda + 21 = 0$$

$$3\lambda^2 - 10\lambda + 7 = 0$$

$$8. f(x) = 2 \tan^{-1} x + \pi - 2 \tan^{-1} x$$

$$f(x) = \pi$$

$$f(5) = \pi$$

9. $\alpha = 2 + 3i; \beta = 2 - 3i$

$$\alpha\beta\gamma = \frac{13}{2}$$

$$(4+9)\gamma = \frac{13}{2}$$

$$\gamma = \frac{1}{2}$$

10. hyperbola is

$$\frac{x^2}{4} - \frac{y^2}{9} = 1$$

$$\text{foci } (\pm\sqrt{13}, 0)$$

$$e = \frac{\sqrt{13}}{2}$$

$$e_1 \times \frac{\sqrt{13}}{2} = \frac{1}{2}$$

$$e_1 = \frac{1}{\sqrt{13}}$$

equation of ellipse

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

$$(\sqrt{13}, 0)$$

$$a^2 = 13$$

$$\text{foci of ellipse } \sqrt{a^2 - b^2} = a \cdot \frac{1}{\sqrt{13}}$$

$$13 - b^2 = 1$$

$$b^2 = 12$$

equation of ellipse

$$\frac{x^2}{13} + \frac{y^2}{12} = 1$$

11. $a_1 a_2 a_3$

$$a_2 = \frac{3a}{3} = 13$$

$$d = 3$$

sum of last four term = 178

$$a_{n-3} a_{n-2} a_{n-1} a_n$$

$$\text{Their mean} = \frac{178}{4} = 44.5$$

$$a_n = 44.5 + 1.5 + 3$$

$$= 49$$

$$\text{Median} = \frac{10 + 49}{2} = \frac{59}{2} = 29.5$$

12. $n(p) = 25\%$

$$n(c) = 15\%$$

$$n(P' \cup C') = 65\%$$

$$n(P \cup C) = 35\%$$

$$n(P \cap C) = n(P) + n(C) - n(P \cup C)$$

$$25 + 15 - 35 = 5\%$$

$$x \times 5\% = 2000$$

$$x = 40,000$$

13. $f\left(\frac{1}{r}\right) = \int_1^{1/x} \frac{\ln t}{1+t} dt$

$$\text{let } t = \frac{1}{z}$$

$$dt = -\frac{1}{z^2} dz$$

$$= \int_1^x \frac{\ln z}{z(z+1)} dz$$

$$t(x) + f\left(\frac{1}{r}\right) = \int_1^x \frac{\ln x}{z} dz$$

$$= \left[\frac{(\ln z)^2}{2} \right]_1^x = \frac{(\ln x)^2}{2}$$

$$14. \frac{{}^n C_r}{1} = \frac{{}^n C_{r+1}}{7} = \frac{{}^n C_{r+2}}{42}$$

By solving line get $r = 6$
 so, it is 7th term.

$$15. |\vec{a} + \vec{b}| = \sqrt{3}$$

angle between \vec{a} and \vec{b} is 60° .

$\vec{a} \times \vec{b}$ is \perp to plane containing \vec{a} and \vec{b}

$$\vec{c} = \vec{a} + 2\vec{b} + 3(\vec{a} \times \vec{b})$$

$$|\vec{c}| = \sqrt{|\vec{a}|^2 + 4|\vec{b}|^2 + 2 \cdot 2|\vec{a}|^2 \cos 60^\circ \vec{n}_1 + 3|\vec{a}||\vec{b}| \sin 60^\circ \vec{n}_2}$$

$$+ 3|\vec{a}||\vec{b}| \sin 60^\circ \vec{n}_2$$

$$\vec{n}_1 \perp \vec{n}_2$$

$$|\vec{c}|^2 = (1 + 4 + 2) + 9 \times \frac{3}{4}$$

$$|\vec{c}|^2 = 7 + 27/4 = 55/4$$

$$2|\vec{c}| = \sqrt{55}$$

$$\text{so, } h = \frac{4}{\sin 45^\circ} = 4\sqrt{2}$$

16. Equation of line L

$$\frac{x}{2} + \frac{y}{4} = 1$$

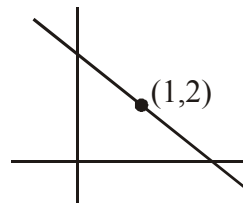
$$2x + y = 4 \dots \dots (1)$$

4 line

$$x - 2y = -4 \dots \dots (2)$$

solving there two

$$\left(\frac{4}{5}, \frac{12}{5} \right)$$



17. $\frac{\sin A}{\sin B} = 2 + \sqrt{3}$

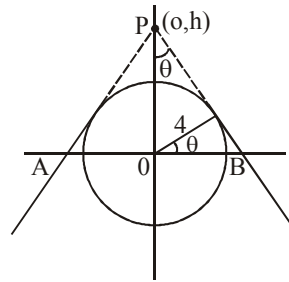
$$\frac{\sin(105^\circ)}{\sin(15^\circ)} = 2 + \sqrt{3}$$

$$\frac{\cos 15^\circ}{\sin 15^\circ} = 2 + \sqrt{3}$$

18. $OP = \frac{4}{\sin \theta}$

$$OB = \frac{4}{\cos \theta}$$

$$\text{Area} = OP \times OB = \frac{16}{\sin \theta \cos \theta} = \frac{32}{\sin 2\theta}$$



least value $\sin 2\theta = 1 \theta = 45^\circ$

19. $\lim_{x \rightarrow 0} \frac{2x e^{x^2} + \sin x}{2 \sin x \cos x}$

$$\lim_{x \rightarrow 0} \left(\frac{x}{\sin x} e^{x^2} + \frac{1}{2} \right) \frac{1}{\cos x} = 1 + \frac{1}{2} = \frac{3}{2}$$

20. $\sum_{r=16}^{20} (r^2 - r - 6) = 7780$

21. Given that $y + 3x = 0$ equation of a chord of the circle then

$$y = -3x \dots (i)$$

$$x^2 + (-3x)^2 - 30x = 0$$

$$10x^2 - 30x = 0$$

$$10x(x - 3) = 0$$

$$x = 0 \text{ or } y = 0$$

so the equation of the circle is

$$(x - 3)(x - 0) + (y + 9)(y - 0) = 0$$

$$x^2 - 3x + y^2 + 9y = 0$$

$$x^2 + y^2 - 3x + 9y = 0$$

22.
$$\int \frac{dx}{(x+1)^{3/4} (x-2)^{5/4}}$$

$$\int \frac{dx}{\left(\frac{x+1}{x-2}\right)^{3/4} (x-2)^2}$$

put $\frac{x+1}{x-2} = E$

$$\frac{-3}{(x-2)^2} = \frac{dt}{dx}$$

23. Given that

$$x = 2 \cos t + 2t \sin t$$

$$\text{so, } \frac{dx}{dt} = -2 \sin t + 2[t \cos t + \sin t]$$

$$\frac{dx}{dt} = 2 \cos t - 2[-t \sin t + \cos t]$$

$$\frac{dy}{dx} = 2t \sin t \dots (ii)$$

$$\frac{dy}{dx} = \frac{2t \sin t}{2t \sin t}$$

$$\frac{dy}{dx} = \tan t$$

$$\left(\frac{dy}{dx}\right)_{t=\pi/4} = 1$$

so the slope of the normal is -1

$$\text{and at } t = \pi/4, x = \sqrt{2} + \frac{\pi}{2\sqrt{2}} \text{ and } y = \sqrt{2} - \pi/2\sqrt{2}$$

to the equation of normal is

$$\left[y - \left(\sqrt{2} - \pi/2\sqrt{2}\right)\right] = -1 \left[x - \left(\sqrt{2} + \pi/2\sqrt{2}\right)\right]$$

$$y - \sqrt{2} + \frac{\pi}{2\sqrt{2}} = -x + \sqrt{2} + \pi/2\sqrt{2}$$

$$x + y = 2\sqrt{2} \text{ so the distance from the origin is } 2$$

$$24. \quad \frac{x-1}{\alpha} = \frac{y+1}{-1} = \frac{z-0}{1} = L_1$$

$$x + y + z + 1 = 0$$

$$2x - y + 7 + 3 = 0 = L_2$$

so point P(0,1,-2) [on line L₂]

point on other line [on line L₁]

Q (1, -1, 0) [on line L₂]

Q (1, -1, 0)

$$\overrightarrow{PQ} = \hat{i} - 2\hat{j} + 2\hat{k}$$

vector \perp to line L₂

$$\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & 1 & 1 \\ 2 & -1 & 1 \end{vmatrix} = 2\hat{i} + \hat{j} - 3\hat{k}$$

vector \perp to L₂

$$\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ \alpha & -1 & 1 \\ 2 & 1 & -3 \end{vmatrix}$$

$$\vec{n} = 2\hat{i} + \hat{j}(3\alpha + 2) + \hat{k}(\alpha + 2)$$

$$\text{distance} = \overrightarrow{PQ} \cdot \hat{m}$$

$$= \frac{2 - 2|3\alpha + 2| + 2(\alpha + 2)}{\sqrt{4 + (3\alpha + 2)^2 + (\alpha + 2)^2}} = \frac{1}{\sqrt{3}}$$

$$\Rightarrow 3(2 - 4\alpha)^2 = 10\alpha^2 + 16\alpha + 12$$

$$\Rightarrow 6[1 + 4\alpha^2 - 4\alpha] = 5\alpha^2 + 8\alpha + 6$$

$$\Rightarrow 19\alpha^2 - 32\alpha = 0$$

$$\Rightarrow \alpha = \frac{32}{19}$$

25. Given that

$$A = \begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix}$$

$$A^2 = \begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix} \Rightarrow A^2 = -I$$

$$A^3 = \begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}$$

$$A^4 = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = I$$

$$A^2 + I = A^3 - A$$

$$-I + I = A^3 - A$$

$$A^3 \neq A$$

26. Required probability is

$$\frac{{}^{10}C_0^2 + {}^{10}C_1^2 + {}^{10}C_2^2 + \dots + {}^{10}C_{10}^2}{2^{10}}$$

$$= \frac{{}^{20}C_{10}}{2^{20}}$$

27. $x^2 - y + 6 = 0$

$$2x - \left(\frac{y+10}{2}\right) + 6 = 0$$

$$4x - y - 10 + 12 = 0$$

centre of circle $(-4, 2)$

$$\frac{x+4}{4} = \frac{y-2}{-1} = -\frac{(16-2+2)}{17}$$

$$\left(\frac{-8}{17}, \frac{2}{17}\right)$$

28. The contrapositive of the statement is "If it is not raining, then it will not come"

29. Radius

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

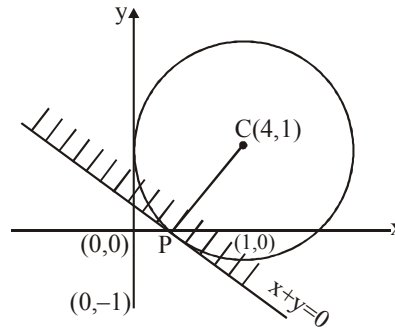
$$= \frac{5}{\sqrt{2}} = \frac{5\sqrt{2}}{2}$$

$$\frac{dx}{(x-2)^2} = -\frac{dt}{3}$$

$$= -\frac{1}{3} \int \frac{dt}{t^{3/4}} = -\frac{1}{3} \int t^{-3/4} dt$$

$$= -\frac{1}{3} \left[\frac{t^{-3/4+1}}{-3/4+1} \right]$$

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



30. $(x+2) \frac{dy}{dx} = x^2 + 4x - 9 \quad x \neq -2$

$$\frac{dy}{dx} = \frac{x^2 + 4x - 9}{x+2}$$

$$dy = \frac{x^2 + 4x - 9}{x+2} dx$$

$$\int dy = \int \frac{x^2 + 4x - 9}{x+2} dx$$

$$y = \int \left(x+2 - \frac{13}{x+2} \right) dx$$

$$y = \int (x+2) dx - 13 \int \frac{1}{x+2} dx$$

$$y = \frac{x^2}{2} + 2x - 13 \log|x+2| + c$$

Given that $y(0) = 0$

$$0 = -13 \log z + c$$

$$y = \frac{x^2}{2} + 2x - 13 \log|x+2| + 13 \log 2$$

$$y(-4) = 8 - 8 - 13 \log 2 + 13 \log 2 = 0$$