BATCH- DROPPER **DATE-10-03-2015**

Practice Test 4 (advance)Paper # 1 (Phy- Solution)

1. (B)

$$k \propto \frac{1}{\ell} \qquad \therefore \frac{k_1}{k} = \frac{\ell}{\ell_1} = \frac{\ell_1 + \ell_2}{\ell_1} = \frac{1+\ell_2}{\ell_1} = 1 + \frac{1}{n} \quad \Rightarrow \quad k_1 = k\left(1 + \frac{1}{n}\right)$$

2. (C) For an adiabatic change in case of a monatomic gas, $TV^{\gamma-1}$ = constant, In this case x itself is $(\gamma - 1)$ and $\gamma = 5/3$ giving the value of x.

3. (D) For no current in G voltage across R must be same as that across cell

A i.e. 2V.

Hence voltage across $500\,\Omega$ is 12 – 2 = 10 V.

Also $500\,\Omega$ & R are in series as current in them are same & hence

$$\frac{R}{500} = \frac{V_R}{V_{500}} = \frac{2}{10}$$

$\Rightarrow$ R = $100\,\Omega$

4. (D) Force for v_4 & v_3 is along +ve z, for v_2 it is zero force on v_1 is –ve among v_4 & v_3 force on v_4 is greater in magnitude as $\vec{v}_4 \perp \vec{B}$.

5. (D) $\frac{dA}{dt} = \frac{r^2\omega}{2}$ is constant $\qquad \therefore \qquad \frac{dA}{dt} = \frac{V_{max} r_{min}}{2}$

$$V_{max} = \frac{2dA/dt}{r_{min}} = 40\text{ k m/s}$$

6. (D) Consider the expression for the current rising exponentially in the LR circuit. The time constant is (L/R). In this case the curve (1) is rising faster than curve (2) indicating that $(L_1 / R_1) < (L_2 / R_2)$. However, in both the cases the maximum current is the same and equal to (V / R_1) or (V / R_2). Which means $R_1 = R_2$

7. (D)

8. (B)

9. (ABCD)

$\omega = 1000$ $X_L = \omega L = 2000\Omega$ $X_C = \frac{1}{\omega C} = \frac{10^6}{1000} = 1000\Omega$

R = 1000Ω z = $\sqrt{(X_L - X_C)^2 + R^2} = 1000\sqrt{2}\Omega$

Power factor $\cos\theta = \frac{R}{Z} = \frac{1}{\sqrt{2}} = 0.707$

$I_{rms} = \frac{V_{rms}}{z} = \frac{200/\sqrt{2}}{1000\sqrt{2}} = 0.1A$

$X_L - X_C =$ positive $\Rightarrow$ inductive circuit voltage leads

10. **(AC)**

11. **(ABCD)**

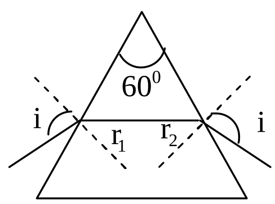
Charge on the capacitor before insertion of dielectric slab = 100 μC

Charge on capacitor after insertion of dielectric slab = 300 μC

Increase in charge on the capacitor = 300 – 100 = 200 μC. Heat produced = 0

Energy supplied by the cell = increase in stored potential energy + work done on the person who filling the dielectric slab .

12. **(A)**



The slab does not contribute to deviation. For minimum deviation by prism.

$r_1 = r_2 = 30^0$ as shown in the figure. $\Rightarrow$ sin i $= \sqrt{2}\sin 30^0$ or $i = 45^0$

$\therefore$ Minimum deviation = 2i – A = 90^0 - 60^0 = 30^0

13. **(B)** When speed of block is maximum , net force on block is zero, Hence at that instant spring exerts a force of magnitude 'mg' on block.

14. **(C)** At the instant block is in equilibrium position . Its speed is maximum and compression in spring is x given by kx = mg ...(1)

From conservation of energy

$mg(L + x) = \frac{1}{2}kx^2 + \frac{1}{2}mv^2_{max}$...(2)

From (1) and (2) we get $v_{max} = \frac{3}{2}\sqrt{gL}$

15. **(B)**

$V_{max} = \frac{3}{2}\sqrt{gL}$ and $\omega = \sqrt{\frac{k}{m}} = 2\sqrt{\frac{g}{L}}$ $\quad \therefore A = \frac{V_{max}}{\omega} = \frac{3}{4}L$

Hence time taken t , from start of compression till block reaches mean position is given by

$x = A\sin\omega t_0$ where $x = \frac{L}{4}$ $\quad \therefore t_0 \sqrt{\frac{L}{4g}}\sin^{-1}\frac{1}{3}$

Time taken by block to reach from mean position to bottom most position is $\frac{2\pi}{4\omega} = \frac{\pi}{4}\sqrt{\frac{L}{g}}$

Hence the required time = $\frac{\pi}{4}\sqrt{\frac{L}{g}} + \sqrt{\frac{L}{4g}}\sin^{-1}\frac{1}{3}$

16. **(C)** **17. (B)** **18. (A)**

$iLB + Kx = ma$ $\; iLB + Kx = ma$ $\quad q = CBLV$ $\; i = \frac{dq}{dt}$ $\quad q = CBLV$

$\Rightarrow i = \frac{dq}{dt} = CBL\frac{dV}{dt} = BLCa$ $\quad B^2L^2Ca + Kx = ma$

$a = \frac{Kx}{m + B^2L^2C}$ $\quad \Rightarrow w = \sqrt{\left(\frac{K}{m + B^2L^2C}\right)}$

19. **(A – q, B – r, C – s)**

20. (A – p,q ; B – r,s ; C – p,q)

(A) Isothermal process, $\Delta U = 0,\ W = +ve \Rightarrow \Delta Q = +ve$

Since volume is increasing in both processes

(B) A is adiabatic with –ve work done $\Rightarrow \Delta U = +ve$

B is isothermal

(C) Same as A

CHEMISTRY (Paper – I Solution)

21. B **22.** C **23.** A **24.** D

25. B $(\lambda_1)_H = 2\pi r_1 = 2 \times 3.14 \times 0.53 A^o = 3.33 A^o$

$\lambda_n = n \times \lambda_1$

13.32 = $n \times 3.33 \Rightarrow$ n = 4 excited state

6.66 = $n \times 3.33 \Rightarrow$ n = 2

$\Delta E = E_4 - E_2 = \frac{hc}{\lambda}$

$\lambda = 486.2\,nm$

26. C $\Delta G^o = -2.3 RT \log Ksp$

13.8 = $-2.3 \times 0.002 \times 300 \log Ksp$

$\log Ksp = \frac{-13.8}{1.38} = -10$

Ksp = 10^{-10}

0.02 N H_2SO_4 = 0.01 M H_2SO_4

$MSO_4 \rightleftharpoons M^{2+} + SO_4^{2-}$

S S

$10^{-10} = S \times (S + 0.01)$

S = 10^{-8} M

27. B

28. D $e^{-Ea/RT} = \frac{1}{100} = 10^{-2}$

$$-\frac{Ea}{RT} = -2.3 \times 2$$

$Ea = 4.6 \times 0.002 \times 300$

$= 2.76$ K.cal

29. A,B

30. A,B,C

$P_4 + 3NaOH + 3H_2O \xrightarrow[\Delta]{} PH_3 + 3NaH_2PO_2$

$2H_3PO_2 \xrightarrow[\Delta]{} PH_3 + H_3PO_4$

$4H_3PO_3 \xrightarrow[\Delta]{} PH_3 + 3H_3PO_4$

31. A, B

$3SO_2 + O_3 \rightarrow 3SO_3$

$3SnCl_2 + 6HCl + O_3 \rightarrow 3SnCl_4 + 3H_2O$

32. A, B **33.** B **34.** C

35. A **36.** A **37.** B

38. A

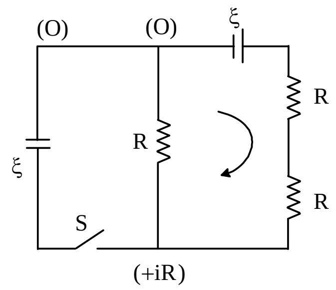
39. A – p,s ; B – p,q,r ; C – p,q ; D – p,s

40. A – q, r,s; B – p ; C – q,r,s ; D - q

Paper 2 (Solution)

1. (B) Photons per area per second at a distance r are $5.00\times10^{18}/4\pi r^2$. Photons per second entering the eye, radius R is then this times πR^2. Set this product equal to 500 per second and solve for r. The result is [B].

2. (C)



$$i = \frac{\xi}{3R}$$

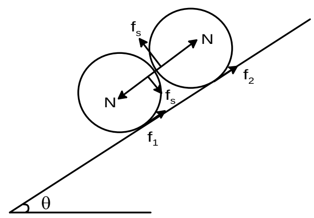
$$V_S = \xi + iR = \xi + \frac{\xi}{3} \Rightarrow V_S = \frac{4\xi}{3}$$

3. (A) $\frac{mv^2}{r} = qvB$

$$\Rightarrow \quad r = \frac{mv}{qB} = \frac{\sqrt{2m(KE)}}{qB} = \frac{\sqrt{2mqV}}{qB} = \sqrt{\frac{2mv}{q}}\frac{1}{B}$$

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

4. (B) $(m_1 + m_2)\ g\sin\theta = 2f_3$

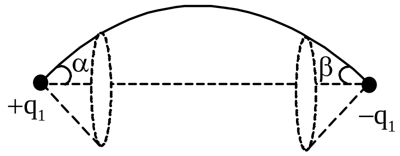


$N + m_1\ g\sin\theta = f_1$ $\quad\quad$ $m_2 g\sin\theta - N = f_2$

$$m_2 g\sin\theta - N = N + m_1 g\sin\theta \quad m_2 > m_1$$

5. (C) Flux passing through the cone will remain same for both

Thus, $\phi_1 = \phi_2$



or $\dfrac{q_1}{2\in_0}(1-\cos\alpha) = \dfrac{q_2}{2\in_0}(1-\cos\beta)$ (using solid angle)

$$q_1 \sin^2\frac{\alpha}{2} = q_2 \sin^2\frac{\beta}{2}$$

6. **(ABC)** In the initial state, charge on each capacitor is shown in figure-1

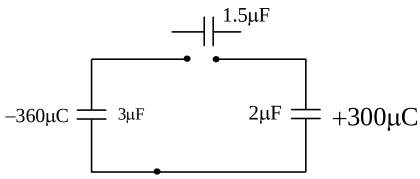


figure − 1

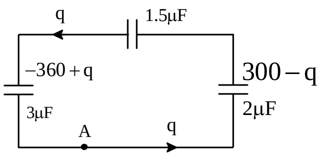


figure − 2

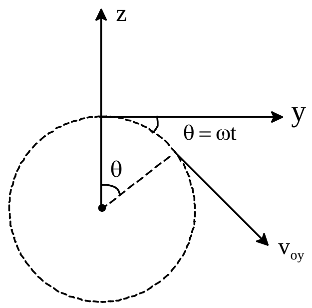
Let charge q flow anticlockwise in the circuit before it achieves steady state as shown in figure.-2. Applying KVL to figure 2.

$-\dfrac{(360-q)}{3} + \dfrac{q}{1.5} - \dfrac{(300-q)}{2} = 0$ or 180 μC

$\therefore$ final charge on 1.5 μF capacitor is q = 180 μC and final charge on 2 μF capacitor is

300- q = 120 μC

7. **(B,D)** The x – component of velocity being parallel to magnetic field , shall remain unchanged. The component of velocity perpendicular to x – axis will always have magnitude V_{oy}, and at any time t it shall make an angle $\theta = \omega t$ with y – axis as shown .



$\therefore$ y – component of velocity is $V_{oy}\cos\omega t$ and z – component of velocity along negative z – direction at any time t is $V_{oy}\sin\omega t$. Where $\omega = \frac{qB}{m}$

8. **(a,b,c,d)** Area under the curve is equal to number of molecules of the gas sample. Hence

$$N = \frac{1}{2}\cdot a\cdot V_0 \Rightarrow aV0 = 2N$$

$$V_{avg} = \frac{1}{N}\int_0^{\infty} V\,N(V)dV = \frac{1}{N}\int_0^{V_0} V\cdot\left(\frac{a}{v_0}\cdot V\right)dV$$

$$= \frac{2}{3}V_0 \Rightarrow \frac{V_{avg}}{V_0} = \frac{2}{3}$$

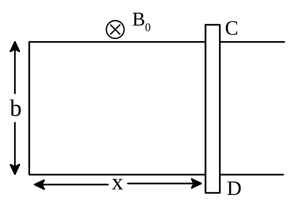
$$V_{rms}^2 = \frac{1}{N}\int_0^{\infty} V^2 N(V)dV = \frac{1}{N}\int_0^{V_0} V^2\left(\frac{a}{V_0}\cdot V\right)dV = \frac{V_0^2}{2}$$

$$\Rightarrow \frac{V_{rms}}{V_0} = \frac{1}{\sqrt{2}}$$

Area under the curve from 0.5 V_0 to V_0 is $\frac{3}{4}$ of total area.

9.(A) The magnetic flux must remain constant

$$\therefore\ \phi_m = B_0ab = \frac{B_0}{1+kt}bx$$



Where x is as shown

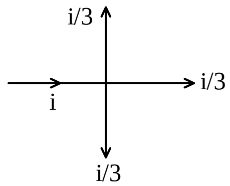
$\therefore$ x = a (1 + kt)

or $v = \frac{dx}{dt} = ak$

10. (A – p,s ; B – p, r ; C – p, s; D – q, s)

11. (A – p,q,r ; B – p,q,r,s ; C – r ; D – p,q,r,s)

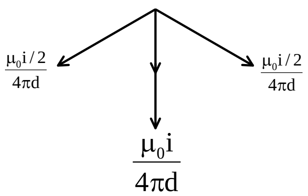
(P)



$\Rightarrow$ not is downward

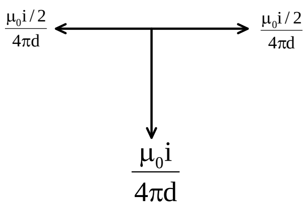
$$\Rightarrow \quad \frac{\mu_0 i}{4\pi d} + \frac{\mu_0 i/3}{4\pi d} \quad \Rightarrow \quad \frac{\mu_0 i}{3\pi d}(-i)$$

(Q)



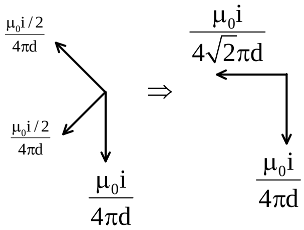
$$\Rightarrow \quad 2\left(\frac{\mu_0 i}{8\pi d}\cos 45^\circ\right) + \frac{\mu_0 i}{4\pi d} \quad \Rightarrow \quad \frac{\mu_0 i}{4\pi d}\left[1 + \frac{1}{\sqrt{2}}\right](-j)$$

(R)



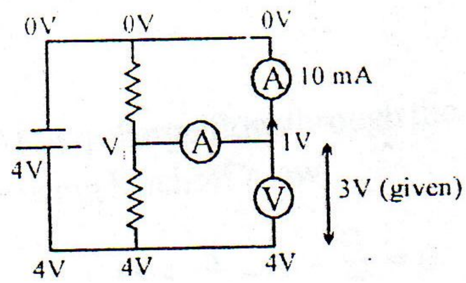
$$\Rightarrow \quad \frac{\mu_0 i}{4\pi d}(-j)$$

(S)



$$\frac{\mu_0 i}{4\sqrt{2}\pi d}(-j)+\frac{\mu_0 i}{4\pi d}(-j)$$

12. (7) R_A = resistance of ammeter



$$\frac{4-V_1}{100}=\frac{V_1-1}{R_A}+\frac{V_1-0}{100} \ldots(1)$$

1V – 0V = (10 mA) R_A

$R_A = 100\Omega$

$$\frac{4-V_1}{100}=\frac{V_1-1}{10Q}+\frac{V_1-0}{100}$$ (By using equation (1) and (2)

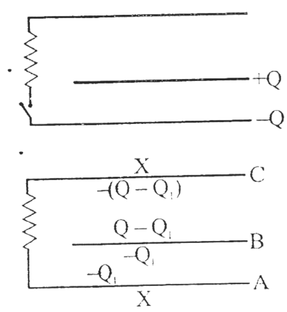
$V_1 = 5/3$ V

$\frac{V_1-1}{R_A}=$ (current in ammeter (II) $\qquad \frac{5/3-1}{100}=6.67\text{mA}$ = 7

13. (1) $u_i=\frac{Q^2 d}{2\varepsilon_0 A}$

then

$V_C = V_A$ (At equilibrium condition) $\qquad V_{AB} = V_{BC}$



$$U_f=\frac{Q_1^2 d}{\varepsilon_0 A}+\frac{(Q-Q_1)^2\,2d}{\varepsilon_0 A}=\frac{Q^2 d}{3\varepsilon_0 A}$$

$$\frac{Q_1 d}{\varepsilon_0 A}=\frac{Q-Q_1(2d)}{\varepsilon_0 A}$$

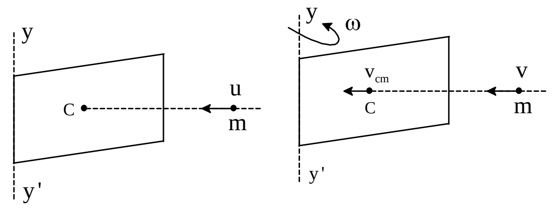
$Q_1 = 2(Q - Q_1)$

$3Q_1 = 2Q$

$$U_f=\frac{Q_1^2 d}{\varepsilon_0 A}+\frac{(Q-Q_1)2d}{\varepsilon_0 A}=\frac{Q^2 d}{3\varepsilon_0 A}$$

$$\Delta_u = \frac{Q^2 d}{2\varepsilon_0 A} - \frac{Q^2 d}{3\varepsilon_0 A} = \frac{Q^2 d}{6\varepsilon_0 A} = \frac{(60)^2}{6(6)} = 0.1\text{mJ}$$. So x = 1

14. (5) The plate is free to rotate about vertical axis yy'.



Let v, v_{cm} and ω be the velocity of particle, velocity of centre of mass of plate and angular velocity of plate just after collision.

∴ From conservation of angular momentum about vertical axis passing though O is

$$mu\frac{a}{2} = mv\frac{a}{2} + \frac{ma^2}{3}\omega \qquad \text{... (1)}$$

Since the collision is elastic, the equation of coefficient of restitution is

$$e = \frac{v_{cm} - v}{u} = 1 \qquad \text{... (2)}$$

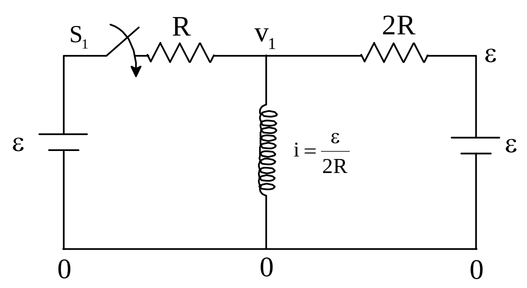
But $$v_{cm} = \frac{a\omega}{2} \qquad \text{... (3)}$$

Solving equation (1), (2) and (3) we get

$$\omega = \frac{12}{7}\frac{u}{a}$$ = 5 rad/s

15.(2) When S_2 is closed current in inductor remains, $i = \frac{\varepsilon}{2R}$

∴ $$\frac{\varepsilon - V_1}{R} + \frac{\varepsilon - V_1}{2R} = \frac{\varepsilon}{2R} \qquad \left(V_1 = \frac{2\varepsilon}{3}\right)$$



∴ Potential difference (V) $= \varepsilon - \frac{2\varepsilon}{3} = \frac{\varepsilon}{3}$ Ans.

And $L\frac{dt}{dt} = \frac{2\varepsilon}{3}$ $\frac{di}{dt} = +\frac{2\varepsilon}{3L}$ = 2000 ; X = 2

16.(4) The light entering the rod does not emerge from the curved surface of the rod when the angle 90 – r is greater than the critical angle.

i.e., $\mu \geq \frac{1}{\sin C}$ where C is the critical angle.

Here C = 90 – r

$\Rightarrow \mu \geq \frac{1}{\sin(90 - r)} \Rightarrow \mu \geq \frac{1}{\cos r}$

As a limiting case $\mu = \frac{1}{\cos r}$ ... (i)

Applying Snell's law at A

$\mu = \frac{\sin\alpha}{\sin r} \Rightarrow \sin r = \frac{\sin\alpha}{\mu}$ ... (ii)

The smallest angle of incident on the curve surface is when $\alpha = \frac{\pi}{2}$. This can be taken as a limiting case for angle of incidence on plane surface.

Form (ii)

$\sin r = \frac{\sin\pi/2}{\mu} \Rightarrow \mu = \frac{1}{\sin r}$ ... (iii)

Form (i) and (ii) sin r = cos r

$\Rightarrow$ r = 45°

$\Rightarrow$ $\mu = \frac{1}{\cos 45^\circ} = \frac{1}{1/\sqrt{2}}$

$\Rightarrow$ $2\mu^2 = 4$

This is the least value of the refractive index of rod for light entering the rod and not leaving it form the curved surface.

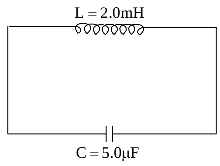
17. Here Q_0 = maximum value of

Q = 200 μC = 2×10^{-4} C

$\omega = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{(2\times10^{-3}H)(5.0\times10^{-6}F)}} = 10^{+4}s^{-1}$ Let at t = 0, Q = Q_0 then ... (1)

Q(t) = Q_0 cos ωt $\qquad$ $I(t) = \frac{dQ}{dt} = -Q_0\omega \sin\omega t$ ... (2)

$\frac{dI(t)}{dt} = -Q_0\omega^2 \cos(\omega t)$ ... (3) $\qquad$ For $Q = 100\mu C\left(\text{or}\frac{Q_0}{2}\right)$



From (1) 100 = 200 $\cos\omega t$ $\qquad$ or $\cos(\omega t) = \frac{1}{2}$, From equation (3):

$\left|\frac{dt}{dt}\right| = (2.0\times10^{-1}C)(10^{+4}s^{-1})^2\left(\frac{1}{2}\right)$ $\qquad$ $\left|\frac{dI}{dt}\right| = 10^{+4}A/s$ But $\left|\frac{dI}{dt}\right| = 10^{x}A/s$ $\therefore$ x = 7

18. (1) Maximum percentage error in Y is given by $Y = \frac{W}{\frac{\pi D^2}{4}}\times\frac{L}{X}$

$$\left(\frac{\Delta Y}{Y}\right)_{max} = 2\left(\frac{\Delta D}{D}\right) + \frac{\Delta X}{X} + \frac{\Delta L}{L}$$

$$= 2\left(\frac{0.001}{0.05}\right) + \left(\frac{0.001}{0.125}\right) + \left(\frac{0.1}{110}\right) = 0.0489$$

So maximum percentage = 4.89% $\qquad$ It is given that

$W = 50N; D = 0.05cm; = 0.05\times10^{-2}m;$ $\qquad$ X = 0.125 cm = 0.125 x 10^{-2} m ;

L = 110 cm = 110 x 10^{-2} m $\qquad$ $Y = \frac{50\times4\times110\times10^{-2}}{3.14\left(0.05\times10^{-2}\right)\times\left(0.125\times10^{-2}\right)}$

= 2.24 x 10^{11} N/m^2 $\qquad$ $\therefore \Delta Y = 0.0489\times2.24\times10^{11} = 1.09\times10^{10}N/m^2$

$\simeq 11\times10^9 N/m^2$ $\qquad$ $\therefore$ x = 11

19. Rate of water coming from Tap T is 0.021 x 10^{-5} m^3 / minute

$F = \frac{2.1\times10^{-5}}{60}m^3/\sec$ $F = \frac{2.1\times10^{-5}}{60}m^3/\sec$

same amount of water should be ejected in from of steam.

So heat supplied must be $\Delta Q = \Delta mS\Delta T + \Delta mL$ or Rate of heat transfer

$$\frac{\Delta Q}{\Delta t} = \frac{\Delta m}{\Delta t}S\Delta T + \frac{\Delta m}{\Delta t}L$$

$P = \rho FS\Delta T + \rho FL$ $\qquad$ $\left(\therefore \frac{\Delta m}{\Delta t} = \rho\times F\right)$

P = $\frac{1000\times2.1\times10^{-5}}{60}[4.2\times(100-20)+2300]kJ/\sec$

P = 922.6 (J/sec. or watt). P/100 = 9.22 = 9

Paper – II

Solution

20. C **21.** A **22.** B **23.** A **24.** A **25.** A,B,C **26.** A,B,C

27. A,C **28.** A,B,C

29. A – q,s; B – p,s; C – s ; D – p,r

30. A-q,s; B-p,q,s; C-p,q; D-r

31. 4 **32.** 4 **33.** 8

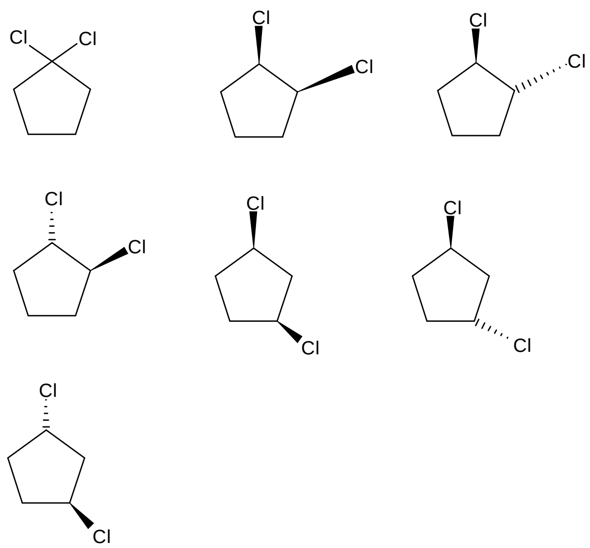
34. 2

$N_1V_1 = N_2V_2$

$1 \times 20 = 20 \times N_2$

$N_2 = 1 = 5 \times M \Rightarrow M = 0.2 = 2 \times 10^{-1}$

35. 7



36. 5 At equilibrium $\Delta G = \Delta H - T\Delta S = 0$

$$T = \frac{\Delta H}{\Delta S} = \frac{10 \times 1000}{20} = 500K = 5 \times 10^2 K$$

37. 5 Average life T = 1.44 $\times$ $t_{1/2}$ = $\frac{43.2}{60} = 0.72\,h$

$$t_{1/2} = \frac{0.72}{1.44} = \frac{1}{2}h$$

Time for 99.9% disintegration 10 $\times$ $t_{1/2}$

= $10 \times \frac{1}{2} = 5\,h$

38. 5

0.88 = 0.34 – $(-0.059 \times pH)$ pH = $\frac{0.54}{0.059} = 9$

5 = pKb + $\log\frac{0.1}{0.2}$ 5 = $pKb - 0.3$

pKb = 5.3 pH = $7 - \frac{1}{2}\left[5.3 + \log 5 \times 10^{-2}\right]$ = $7 - \frac{1}{2}[5.3 + 0.7 - 2]$ = 5