



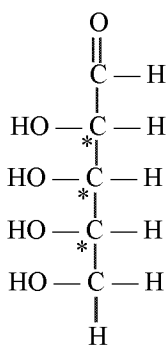
# NEET

## TEST-4-SOLUTIONS

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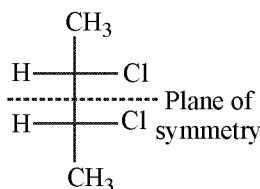
STANDARD ANSWER KEY											
Q	1	2	3	4	5	6	7	8	9	10	11
A	C	B	D	C	C	C	B	C	B	C	B
Q	12	13	14	15	16	17	18	19	20	21	22
A	D	B	B	B	D	A	B	C	D	A	D
Q	23	24	25	26	27	28	29	30	31	32	33
A	A	B	A	C	B	A	B	C	A	B	A
Q	34	35	36	37	38	39	40	41	42	43	44
A	B	D	C	B	A	D	C	A	B	B	A
Q	45	46	47	48	49	50	51	52	53	54	55
A	C	D	C	D	A	C	A	A	B	B	A
Q	56	57	58	59	60	61	62	63	64	65	66
A	C	D	D	B	D	A	A	C	C	C	B
Q	67	68	69	70	71	72	73	74	75	76	77
A	B	B	B	D	C	D	A	A	D	D	B
Q	78	79	80	81	82	83	84	85	86	87	88
A	D	C	C	D	D	C	D	B	D	B	A
Q	89	90	91	92	93	94	95	96	97	98	99
A	A	D	C	D	A	B	C	B	D	B	B
Q	100	101	102	103	104	105	106	107	108	109	110
A	B	A	D	B	D	B	B	A	D	D	D
Q	111	112	113	114	115	116	117	118	119	120	121
A	A	A	A	A	C	B	D	D	C	B	D
Q	122	123	124	125	126	127	128	129	130	131	132
A	C	A	A	B	B	B	B	A	C	A	A
Q	133	134	135	136	137	138	139	140	141	142	143
A	C	A	B	B	B	A	D	A	D	D	A
Q	144	145	146	147	148	149	150	151	152	153	154
A	B	A	A	B	D	A	B	C	A	D	D
Q	155	156	157	158	159	160	161	162	163	164	165
A	D	A	D	D	B	C	A	B	C	A	D
Q	166	167	168	169	170	171	172	173	174	175	176
A	B	A	B	C	C	D	C	D	C	B	A
Q	177	178	179	180							
A	C	A	A	B							

- (1) (C). Since alcohols and carboxylic acids contain an electronegative atom (oxygen) bonding directly to hydrogen, these groups are capable of hydrogen bonding.
- (2) (B). A cyclopentane is a cyclic alkane with five carbons. A cis cyclic compound has both of its substituents on the same side of the ring. Only choices B and C have two substituents, so A and D can be ruled out. In fact, choice C is a trans compound, so the correct answer must be B. Ethoxy and methoxy represent ether substituents, and they must be on adjacent carbons on the same side of the molecule. Thus, the structure of cis-1-ethoxy-2-methoxycyclopentane is given by choice B.
- (3) (D). Both aldehyde and carboxylic acid functional groups are located on the terminal ends of carbon backbones. As a result, the carbon to which they are attached is named C-1, and choice D is correct. Ketones are always internal to the carbon chain.
- (4) (C). The maximum number of stereoisomers of a compound equals  $2^n$ , where  $n$  is the number of chiral carbons in the compound. Here, there are three chiral carbon atoms ( $n = 3$ ) marked by asterisks in the following figure:



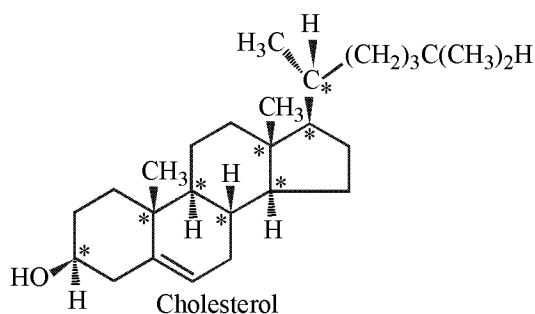
So the number of stereoisomers it can form is  $2^n = 2^3 = 8$ . Hence, the correct choice is C.

- (5) (C). The answer choice is an example of a meso compound: a compound that contains chiral centers but is superimposable on its mirror image. A meso compound can also be recognized by the fact that one half of the compound is the mirror image of the other half:



As a result of this internal plane of symmetry, the molecule is achiral and hence optically inactive. Choices A and B are enantiomers of each other and will certainly show optical activity on their own. Choice D, since it contains a chiral carbon, is optically active as well.

- (6) (C). Remember, to be a chiral center, a carbon must have four different substituents. There are eight stereocenters in this molecule; these are marked below with asterisks.



Other carbons are not chiral, for various reasons. Many are bonded to two hydrogens; others participate in double bonds, which count as two bonds to the same thing (another C atom).

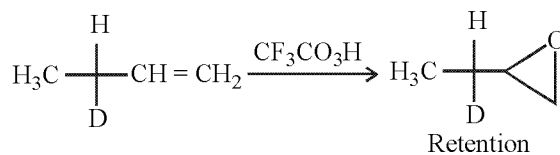
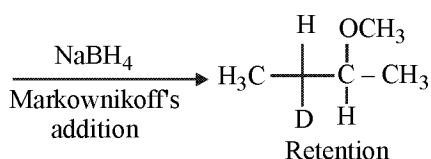
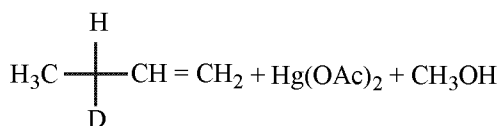
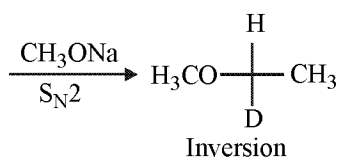
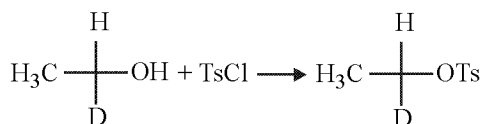
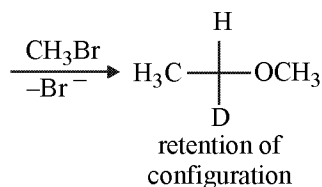
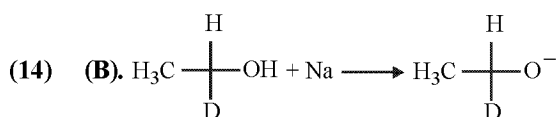
- (7) (B). This is a chair conformation where the two equatorial methyl groups are trans to each other. Since the methyl hydrogens do not compete for the same space as the hydrogens attached to the ring, this conformation ensures the least amount of steric strain. Choice A would be more unstable than choice B since the diaxial methyl group hydrogens are closer to the hydrogens on the ring, causing greater steric strain. Choice C is wrong because it is in the more unstable boat conformation. Choice D is incorrect because these are all different structures with different stabilities.
- (8) (C). The four bonds point to the vertices of a tetrahedron, which means that the angle between two bonds is  $109.5^\circ$ .  $sp^3$  orbitals have an angle of  $109.5^\circ$  between them. Hence, the carbon atom of  $CH_4$  is  $sp^3$ -hybridized. The correct choice, therefore, is C.
- (9) (B). An  $S_N1$  reaction is a first-order nucleophilic substitution reaction. It is called first-order because the rate-limiting step involves only one molecule; thus the correct answer is choice B. Choice A is incorrect because the rate-limiting step is not necessarily the first step to occur in a reaction. It is simply the slowest step. Choice C is a true statement, but is incorrect because it is irrelevant to the term "first-order." Finally, choice D is incorrect because it is the rate-limiting step, not the reaction, that involves only one molecule.
- (10) (C). The correct answer is choice C, dimethyl sulfoxide.  $S_N2$  reactions give the best results if a polar aprotic solvent is used.  $S_N2$  reactions occur via a one-step mechanism in which a nucleophile attacks a substrate. Polar aprotic solvents accelerate this reaction by allowing the nucleophile to be "naked," i.e., not surrounded by hydrogen-bonded solvation spheres. The nucleophile therefore has easy access to the substrate. In addition, the solvent should be polar to dissolve the reactants. Choice A, water, and choice B, ethanol, are both incorrect because although these

are polar, they are also protic and would diminish the power of the nucleophile. Choice D is hexane and is incorrect because it is a nonpolar solvent.

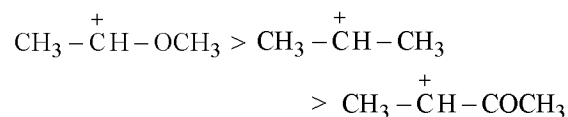
- (11) (B). Inversion of configuration is a trademark of the  $S_N2$  reaction, whereas racemization is typical of  $S_N1$  reactions. When (S)-2-bromobutane is treated with hydroxide, a compound with an R configuration is obtained. The most likely occurrence is a substitution reaction, and the fact that the absolute configuration has changed suggests an  $S_N2$  reaction. If the reaction proceeded by  $S_N1$ , the products would have both R and S configurations because the hydroxide ion could attack the planar carbocation from either side. There is only one configuration in this case, and therefore the correct answer is  $S_N2$ .

- (12) (D). Since a tertiary haloalkane has been converted to an alkene, this is an elimination reaction. This particular compound, 2-chloro-2-methylpropane, can react through either E1 or E2 depending on the conditions: Reaction with strong bases leads to E2, and reaction with weak bases leads to E1. Since methoxide is a strong base, elimination occurs by the E2 mechanism. Choice D is the correct response.

- (13) (B).



- (15) (B). The dispersal of the charge stabilizes the carbocation. More the number of electron donating groups are present, greater the dispersal of positive charge and therefore more the stability of carbocation can be observed. So, the order is



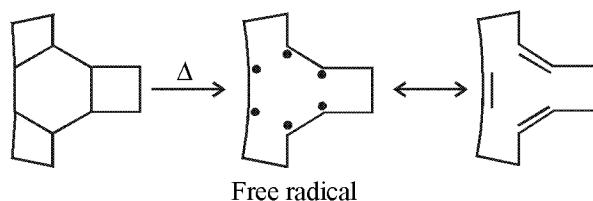
- (16) (D). When the ends of alkene containing n double bonds are different, the number of geometrical isomers is  $2^n$ . Thus for  $\text{CH}_3 - \text{CH} = \text{CH} - \text{CH} = \text{CH} - \text{Cl}$ .  
Number of geometrical isomers =  $2^2 = 4$   
When the ends of alkene containing n double bonds are same, then the number of geometrical isomers =  $2^{n-1} + 2^{p-1}$ .

where  $p = \frac{n}{2}$  for even n and  $\frac{n+1}{2}$  for odd n, thus for

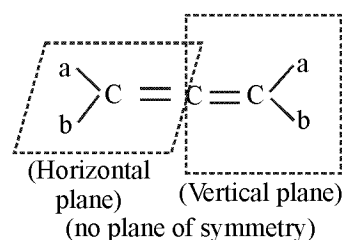


$$= 2^{2-1} + 2^{\frac{2}{2}-1} = 2^1 + 2^0 = 2 + 1 = 3.$$

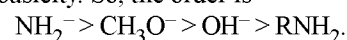
- (17) (A).



- (18) (B). Allenes with even number of cumulative double bonds are optically active if both sides are disymmetric.

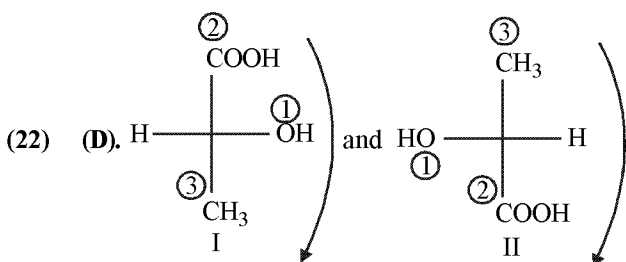


- (19) (C). If the nucleophilic atoms are in the same row of the periodic table, nucleophilicity is approximately in order of basicity. So, the order is

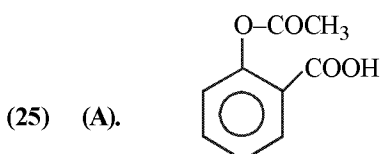
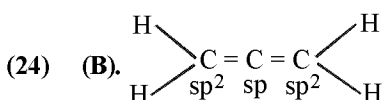
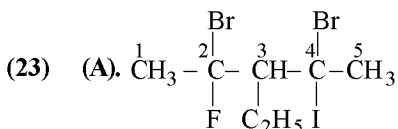


- (20) (D). Substituent with strong +R effect, +I effect and weaker -I effect increases the basicity. Hence  $pK_b$  decreases. Also, alkylamines are stronger bases than arylamines. So, the order is (D).

(21) (A).



Both the above structures are identical and have R configuration but structure I is most appropriate as in it COOH group occupy the uppermost position.



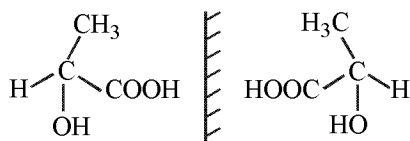
Aspirin (Acetyl salicylic acid)

(26) (C). Maximum -I effect - Cl

(27) (B). Rate of electrophilic substitution reaction

$\propto$  Stability of arenium ion.

(28) (A). The compound which is non-superimposable on its mirror image, is called optically active or chiral and its two non-superimposable mirror images are called enantiomers which have all physical and chemical properties same and also rotate the plane polarised light upto same extent but in opposite direction.



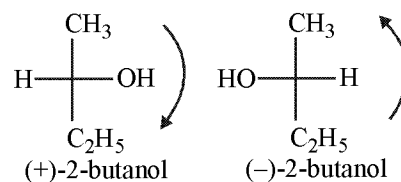
enantiomers of lactic acid

(29) (B).  $\text{CH}_3\text{CHO} \xrightarrow{\text{Tautomerisation}} \text{CH}_2 = \text{CH} - \text{OH}$   
 acetaldehyde vinyl alcohol

Thus, these two are tautomers.

Eclipsed and staggered ethane are two conformations of ethane.

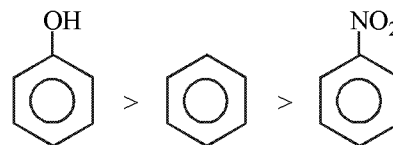
(+) 2-butanol and (-) 2-butanol are enantiomers as these are non-superimposable mirror images.



$\text{CH}_3\text{NHC}_3\text{H}_7$  (methyl-n-propylamine) and  $\text{C}_2\text{H}_5\text{NHC}_2\text{H}_5$  (diethylamine)

Due to difference in the nature of alkyl groups attached to the same functional group, these are called metamers.

(30) (C). Due to strong +R effect of -OH group, the electron density in phenol (I) is much more than in benzene (III) while due to the strong -R effect of the -NO<sub>2</sub> group, the electron density in nitrobenzene (II) is much lower than in benzene. Hence, the order of reactivity towards nitration is as

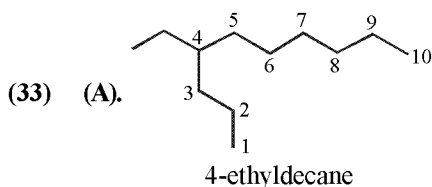


(31) (A). Percentage of S =  $\frac{32 \times \text{weight of BaSO}_4 \times 100}{233 \times \text{weight of compound}}$

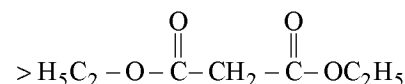
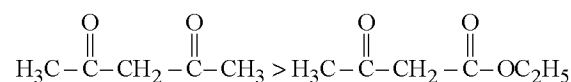
$$= \frac{32 \times 0.233 \times 100}{233 \times 0.16} = 20$$

(32) (B). -OH group is ortho/para directing and makes the benzene ring more active towards electrophilic substitution.

Thus, ortho/para substitution in phenol by an electrophile is very facile.

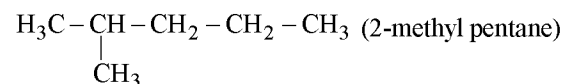


(34) (B). The acid strength of active methylene group is



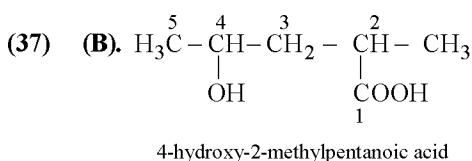
Because ester group has O-R group which decreases electron withdrawing nature of carbonyl group.

(35) (D). Hexane  $\xrightarrow{\text{Anhy. AlCl}_3/\text{HCl}}$



This involves hydride shift and methyl shift resulting in more stable carbocation.

(36) (C). As electron withdrawing group strengthens C-Cl bond, the reaction rate decreases.



(38) (A).

(39) (D). No. of chiral C-atoms are 2

$\therefore$  No. of optical isomers are  $2^n = 2^2 = 4$ .

(40) (C). In p-nitrophenol,  $-\text{NO}_2$  group is an electron withdrawing group which increases the acidic strength of phenols.

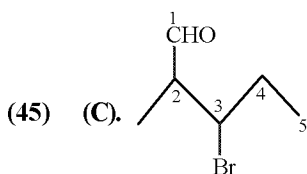
(41) (A). Acetone ( $\text{CH}_3\text{COCH}_3$ ) and propanal ( $\text{CH}_3\text{CH}_2\text{CHO}$ ) are functional isomers.

(42) (B). The total number of paired or unpaired electrons in resonance structures should be the same. The resonance structures are all hypothetical and they do not exist and they cannot be isolated.

(43) (B). Lone pair of electrons present on nitrogen atom easily available, in other cases lone pair of electrons are involved in delocalization.

(44) (A).  $-\text{Cl}$  group is an example for  $-I$  group.

$-I$  group stabilizes  $-\text{COOH}$  group due to their electron withdrawing nature. The release of proton becomes easier.



Root word = Pent- ; Suffix ( $1^\circ$ ) = -ane ; ( $2^\circ$ ) = -al

Prefix = 3-bromo-2-methyl

IUPAC Name: 3-bromo-2-methyl pentanal

(46) (D). The clue words "ideal gas" indicate that the ideal gas law applies. The term isothermal implies that the temperature does not change during the course of the process. For a fixed amount of gas, here 10 moles, this leads to the relationship

$$P_1 V_1 = P_2 V_2 \quad \text{or} \quad P_2 = \frac{P_1 V_1}{V_2}$$

Because the final volume is  $1/3$  of the original volume, the final pressure must be 3 times the original pressure.

(47) (C). This results can be obtained from the formula

$$v_{\text{rms}} = \sqrt{\frac{3RT}{M}} = \sqrt{\frac{3 \times 8.31 \text{ (J/K)} \times 40 \text{ (K)}}{4 \text{ (g/mol)} \times 10^{-3} \text{ (kg/g)}}$$

Note that the quantity  $3R$  is approximately 25. Next, cancel and collect powers of 10 to get

$$v_{\text{rms}} = \sqrt{25 \times 10 \times 1000} = 500 \text{ m/s}$$

A common error in this problem is to forget to convert the molar mass into kilograms from grams.

(48) (D). Getting the right answer here requires you to pay attention to units. You must also read the question carefully. Choice (A) is the total length of the heated rod, but that is not what is asked. The problem asks for the difference in the length. This is given by

$$\Delta l = \alpha l_0 \Delta T = 5 \times 10^{-6} \text{ (}^\circ\text{C)}^{-1} \times 1\text{m} \times (120^\circ\text{C} - 20^\circ\text{C}) = 5 \times 10^{-4} \text{m} = 0.5 \text{mm}$$

(49) (A). The work involved in a given process is equal to the area under the path the process takes on the P-V diagram. Obviously, path A encloses the most area and so the most work is performed during that process.

(50) (C). The internal energy of a monatomic ideal gas is given

$$\text{by } U = \frac{3}{2} nRT.$$

The only difference between container A and B is volume. If we consider the ideal gas law, twice the volume must contain twice the amount of gas under identical conditions. Twice the gas means that the number of moles in A is twice the number of moles in B.

(51) (A). In series combination,

$$\frac{t}{K_1} + \frac{t}{K_2} = \frac{2t}{K} \Rightarrow \frac{1}{K_1} + \frac{1}{K_2} = \frac{2}{K} \Rightarrow K = \frac{2K_1 K_2}{K_1 + K_2}$$

(52) (A).

(53) (B).  $\lambda_m T = 2.898 \times 10^{-3} \text{ mK}$

$$\lambda_m = \frac{2.9 \times 10^{-3}}{10^6} = 2.9 \times 10^{-9} \text{m} = 2.9 \text{nm}.$$

It lies in the X-ray region of the electromagnetic spectrum.

(54) (B).  $\rho = \frac{PM}{RT}$  or  $\rho \propto \frac{P}{T}$

$$\left(\frac{P}{T}\right)_A = \frac{P_0}{T_0} \quad \text{and} \quad \left(\frac{P}{T}\right)_B = \frac{3}{2} \left(\frac{P_0}{T_0}\right)$$

$$\left(\frac{P}{T}\right)_B = \frac{3}{2} \left(\frac{P}{T}\right)_A \quad \therefore \quad \rho_B = \frac{3}{2} \rho_A = \frac{3}{2} \rho_0$$

(55) (A).  $\eta_1 = 1 - \frac{T_L}{T_H} = \frac{W}{Q_1} = \frac{1}{6}$  or  $5T_H - 6T_L = 0$  .... (1)

$$\eta_2 = 1 - \frac{T_L - 62}{T_H} = 2\eta_1 = \frac{1}{3} \quad (\text{Given})$$

$$\Rightarrow 1 - \frac{1}{3} = \frac{T_L - 62}{T_H} \quad \text{or} \quad 2T_H - 3T_L = -186 \text{ .... (2)}$$

Solving (1) and (2), we get

$$T_H = 372 \text{K} = 99^\circ\text{C}$$

$$T_L = \frac{5}{6} T_H = \frac{5}{6} \times 372 \text{K} = 310 \text{K} = 37^\circ\text{C}$$

(56) (C).  $\frac{T_2}{T_1} = 1 - \eta = 1 - \frac{40}{100} = \frac{3}{5} \Rightarrow T_1 = \frac{5}{3} T_2$

$\Rightarrow T_1 = \frac{5}{3} \times 300 = 500 \text{ K}$

New efficiency  $\eta' = 60\%$

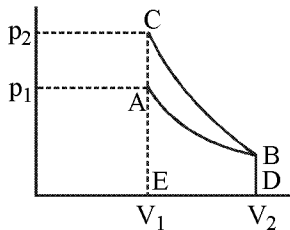
$\frac{T_2}{T_1'} = 1 - \eta' = 1 - \frac{60}{100} = \frac{2}{5} \Rightarrow T_1' = \frac{5}{3} \times 300 = 750 \text{ K}$

(57) (D). In adiabatic process,  $PV^\gamma = k$  ..... (1)  
Given,  $p \propto T^3$  or  $p = kT^3$

$p = k \left( \frac{pV}{R} \right)^3 = \left( \frac{k}{R^3} \right) p^3 V^3$

$\Rightarrow p^2 V^3 = k \Rightarrow pV^{3/2} = k$  ..... (2)

Comparing Eqs. (1) and (2), we get  $\gamma = \frac{3}{2} = \frac{C_p}{C_v}$

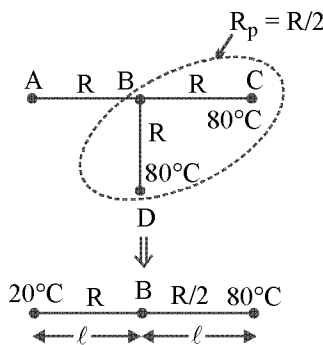


(58) (D).

From graph it is clear that,  $p_2 > p_1$   
Since, area under adiabatic process (BCED) is greater than that of isothermal process (ABDE).

Therefore, net work done  $W_A > W_1 \Rightarrow W < 0$

(59) (B). Since, rod BC and BD are parallel to each other (because both having the same temperature difference). Hence, given figure can be redrawn as follows (R be the resistance of each rod).



$\therefore \frac{Q}{t} = \frac{(\theta_1 - \theta_2)}{R}$  and  $\left( \frac{Q}{t} \right)_{AB} = \left( \frac{Q}{t} \right)_{BD}$

$\Rightarrow \frac{(80 - \theta)}{R/2} = \frac{(\theta - 20^\circ)}{R} \Rightarrow \theta = 60^\circ$

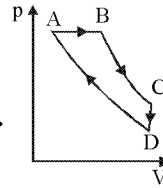
(60) (D). Law of equipartition of energy

$\langle KE_R \rangle = 2 \times \frac{1}{2} kT = E$

$\langle KE_T \rangle = 3 \times \frac{1}{2} kT = \frac{3E}{2}$

(61) (A). As  $p \propto V^2$   
 $T \propto V^3$

i.e. if temperature increases, volume also increases hence w.d. will be positive.



(62) (A).

During process AB, pressure remains constant, during process BC, pressure is decreasing as well as V is increased. During process CD, volume remains constant. During process DA, volume is decreased as well as pressure is increased.

Hence, figure A is equivalent corresponding to the given figure.

(63) (C). Heat supplied at constant pressure  $Q = \mu C_p \Delta T$

Here,  $\Delta T = 40^\circ \text{C}$

$C_p = (7/2) R$  (for diatomic gases)

Number of moles,  $\mu = \frac{14}{28} = \frac{1}{2}$

$\therefore Q = \frac{1}{2} \times \frac{7}{2} R \times 40 = 70 R$

(64) (C). More the surface area, more will be the rate of cooling and hence lesser will be the temperature. Greater the number of surrounding surfaces of the objects having equal area and equal volume, lesser will be the surface area. Among all the given objects, sphere has least and pyramid has largest surface area. Hence the temperature of sphere is highest while that of the pyramid is lowest.

(65) (C).  $\eta = \left[ 1 - \frac{T_2}{T_1} \right] \times 100 = \left[ 1 - \frac{300}{500} \right] \times 100 = 40\%$

(66) (B). Heat energy required to just melt the bullet

$Q = Q_1 + Q_2$

Here,  $Q_1 = ms \Delta \theta = m \times 125 \times (327 - 27) = 3.75 \times 10^4 \text{ m}$

$Q_2 = mL = m \times 2.5 \times 10^4 = 2.5 \times 10^4 \text{ m}$

$\therefore Q = 6.25 \times 10^4 \text{ m}$

If v be the speed of bullet, then 50% of  $\frac{1}{2} mv^2$  should

be equal to Q. Thus,  $0.5 \times \frac{1}{2} mv^2 = 6.25 \times 10^4 \text{ m}$

$\Rightarrow v = \sqrt{\frac{6.25 \times 10^4 \times 2}{0.5}} = 500 \text{ m/s} = 1800 \text{ km/h}$

(67) (B). Work done  $W$  under isothermal change is given by

$$W = RT \times n \log_{10} \left( \frac{V_f}{V_i} \right)$$

where  $V_i$  and  $V_f$  are the initial and final volumes of the gas under isothermal change.

$$\therefore W = RT \times 1 \times \log_{10} (2V/V) \quad [\because n = 1, V_i = V, V_f = 2V]$$

$$= RT \log_{10} (2)$$

(68) (B). Let  $t^\circ\text{C}$  be the temperature of the mixture.

From Calorimetry principle,

Heat given by 10 g of water = Heat taken by 5g of water

$$\text{or } m_1 s_w \Delta T_1 = m_2 s_w \Delta T$$

$$\therefore 10 \times (70 - t) = 5 \times (t - 30)$$

$$\therefore t = 56.67^\circ\text{C}$$

(69) (B). According to Newton's law of cooling,

$$\frac{\theta_1 - \theta_2}{t} = \alpha \left[ \frac{\theta_1 + \theta_2}{2} - \theta_0 \right]$$

For the given conditions

$$\frac{70 - 50}{5} = \alpha \left[ \frac{70 + 50}{2} - 20 \right] \dots\dots\dots (1)$$

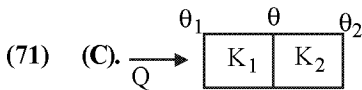
Let  $\theta$  be the temperature after next 10 min. Then,

$$\frac{50 - \theta}{10} = \alpha \left[ \frac{50 + \theta}{2} - 20 \right] \dots\dots\dots (2)$$

Solving Eqs. (1) and (2), we get  $\theta = 30^\circ\text{C}$

(70) (D).  $P \propto T$

$$100 \times \frac{dp}{p} = \frac{dT}{T} \times 100 ; 1 = \frac{1}{T} \times 100 ; T = 100 \text{ K}$$



$$K_1 \left[ \frac{\theta_1 - \theta}{d_1} \right] = K_2 \left[ \frac{\theta - \theta_2}{d_2} \right]$$

$$\theta = \frac{K_1 \theta_1 d_2 + K_2 \theta_2 d_1}{K_1 d_2 + K_2 d_1}$$

(72) (D).  $\frac{d\theta}{dt} \propto \left[ \frac{\theta_i + \theta_f}{2} - \theta_s \right] ; 1 = [55 - x] k$

$$k = \frac{1}{[55 - x]} ; \frac{8}{10} = [46 - x] \times \frac{1}{55 - x}$$

$$x = 10^\circ\text{C}$$

(73) (A).  $\eta = 1 - \frac{T_2}{T_1}$

Efficiency remains same when both  $T_1$  and  $T_2$  are increased by same factor.

(74) (A).  $\frac{V_1}{V_2} = \frac{T_1}{T_2} ; \frac{1}{2} = \frac{300}{T_2} ; T_2 = 600 \text{ K} = 327^\circ\text{C}$

$$\Delta t = 327 - 27 = 300^\circ\text{C}$$

(75) (D).  $K_B = K_A/2$

$$K_B = 3K_C \Rightarrow K_C = K_A/6$$

$$\frac{3\ell}{K_{\text{eff}}} = \frac{\ell}{K_A} + \frac{\ell}{K_A/2} + \frac{\ell}{K_A/6}$$

$$\frac{3\ell}{K_{\text{eff}}} = \frac{9\ell}{K_A} ; K_{\text{eff}} = \frac{K_A}{3}$$

(76) (D).  $Q = mc\Delta\theta$

$$Q \propto m \propto r^3$$

$$\frac{Q_1}{Q_2} = \left( \frac{r_1}{r_2} \right)^3 = \left( \frac{1.5r_1}{r_1} \right)^3 = \frac{27}{8}$$

(77) (B). Frequency is directly proportional to temperature

(78) (D).  $Q \propto K (\Delta t)$

$$\therefore K (100 - T_1) = 2K (T_1 - T_2) = \frac{K}{2} (T_2 - 0)$$

$$\Rightarrow 2 (100 - T_1) = 4 (T_1 - T_2) = T_2$$

$$\therefore 200 - 2T_1 = 4T_1 - 4T_2$$

$$\Rightarrow 6T_1 - 4T_2 = 200 \dots\dots\dots (1)$$

$$\text{Also, } 200 - 2T_1 = T_2 \dots\dots\dots (2)$$

Sub (2) in (1),

$$6T_1 - 800 + 8T_1 = 200 \Rightarrow T_1 = 1000/14 = 71.4 \approx 71$$

(79) (C).  $U \propto T$

As at A & B,  $T$  is same, the internal energy at A & B are equal.

(80) (C). According to Newton's Law of cooling

$$\frac{\theta_i - \theta_f}{t} = k \left[ \frac{\theta_i + \theta_f}{2} - \theta_s \right]$$

$$\frac{1}{t_1} = k \left[ \frac{179}{2} - 30 \right] ; \frac{1}{t_1} = k \left[ \frac{89.5 - 30}{2} \right] = k [59.5]$$

$$t_1 = \frac{1}{k [59.5]}$$

$$\frac{1}{2t_2} = k \left[ \frac{119.5}{2} - 30 \right] = k [29.75] ; t_2 = \frac{1}{k [59.5]}$$

Approximately  $t_1 = t_2$ .

(81) (D).  $\eta = \frac{T_1 - T_2}{T_1} ; \eta_1 = \frac{1}{3}, \eta_2 = \frac{1}{2}, \eta_3 = \frac{2}{5}, \eta_4 = \frac{2}{3}$

(82) (D).  $Q = Q_1 + Q_2$

$$\frac{K'(4R^2) d\theta}{dx} = \frac{K_1 R^2 d\theta}{dx} + \frac{K_2 (3R^2) d\theta}{dx}$$

$$K' = \frac{K_1 + 3K_2}{4}$$

(83) (C). According to Wien's displacement law  $\lambda T = \text{const}$

$$\frac{T_1}{T_2} = \frac{\lambda_2}{\lambda_1} = \frac{480}{360} = \frac{4}{3}$$



(84) (D).  $\eta = 1 - \frac{T_2}{T_1}$  ;  $0.71 = 1 - \frac{273 + 27}{T_1} = 1 - \frac{300}{T_1}$

$$\frac{300}{T_1} = 0.3 ; T_1 = 1000 \text{ K} = 727^\circ\text{C}$$

(85) (B).

(86) (D). The average translational kinetic energy per molecule is proportional to the Kelvin temperature. Since each gas has the same temperature, each has the same average translational kinetic energy. However, this

kinetic energy is  $\frac{1}{2}mv_{\text{rms}}^2$ , and depends on the mass

m. Since each type of molecule has the same kinetic energy, the molecules with the larger masses have the smaller translational rms speeds  $v_{\text{rms}}$ .

(87) (B). Heat required by ice to raise its temperature to  $100^\circ\text{C}$ ,  
 $Q_1 = m_1L_1 + m_1c_1\Delta\theta_1 = 5 \times 80 + 5 \times 1 \times 100$   
 $= 400 + 500 = 900 \text{ cal}$

Heat given by steam when condensed,  
 $Q_2 = m_2L_2 = 5 \times 536 = 2680 \text{ cal}$  as  $Q_2 > Q_1$ .

This means that whole steam is not even condensed. Hence temperature of mixture will remain at  $100^\circ\text{C}$ .

(88) (A).  $dQ = 2 dU \Rightarrow nCdT = 2nC_v dt \Rightarrow C = 2C_v$

$$\Rightarrow C = \frac{2R}{1.5 - 1} = 4R$$

(89) (A). By linear expansion of solids, we have

$$\Delta\ell = \ell \cdot \alpha \cdot \Delta T$$

$$\text{so } \ell_{\text{steel}} \cdot \alpha_{\text{steel}} \cdot \Delta T = \ell_{\text{copper}} \cdot \alpha_{\text{copper}} \cdot \Delta T$$

$$\ell_{\text{steel}} = \frac{\ell_{\text{copper}} \cdot \alpha_{\text{copper}}}{\alpha_{\text{steel}}} = \frac{24 \times 18 \times 10^{-6}}{12 \times 10^{-6}} = 36 \text{ cm}$$

(90) (D). BC is isochoric.  $V_B > V_A$ ,  $V_B = V_C$ ,  $V_D > V_C$

(91) (C). During aerobic respiration when oxygen combines with hydrogen as the final hydrogen acceptor from the electron transport chain, water is formed and released.  $\text{CO}_2$  is produced, not required, as a by-product of the Krebs cycle of aerobic respiration and in alcoholic fermentation. Alcohol is produced during alcoholic (anaerobic) fermentation. Pyruvate is the product of glycolysis and is the raw material for the Krebs cycle (aerobic respiration).

(92) (D). Phototropisms are controlled by an unequal distribution of auxins.

Gibberellins cause excessive stem elongation. Guard cells control the opening and closing of the stomates and, to some extent, are under hormonal control. Ethylene promotes fruit ripening. Cytokinins stimulate cell division and delay aging.

(93) (A). Oxygen plays the role of the final hydrogen acceptor in aerobic respiration, not in photosynthesis. The product of photophosphorylation is ATP, not PGAL, which is the product of the Calvin cycle. The light reactions occur in thylakoid membranes of the grana. There are no membranes in the stroma.

(94) (B). Very little energy (4 ATP) is released from anaerobic respiration of one molecule of glucose, which includes glycolysis and fermentation. Most energy comes from the aerobic phase of respiration, which includes the Krebs cycle and the electron transport chain. Oxidative phosphorylation is the process by which energy is produced during the electron transport chain.

ADP gets phosphorylated into ATP as protons flow through the ATP synthetase channel in the cristae membrane.

(95) (C). The central atom in the head of a molecule of chlorophyll is magnesium and a major component of any commercial fertilizer. The central and active atom in a molecule of hemoglobin is iron, and the active atom in hemocyanin is copper.

(96) (B). The production of ATP in anaerobic respiration (fermentation) is by substrate level phosphorylation, where a kinase enzyme moves a phosphate from 1 molecule to ADP, forming ATP.

(97) (D). During the light-independent reactions, carbon is reduced (carbon fixation) by the Calvin cycle and PGAL is formed.  $\text{CO}_2$  is not released during photosynthesis at all; it is the source of carbon that is reduced in carbon fixation. Oxygen is released during the light reactions as a result of the photolysis of water. ATP is produced during the light reactions and utilized in huge quantities during the light-independent reactions.

(98) (B). Transpiration is loss of water from the leaf by evaporation. The highest rate of evaporation of water would be in an environment that is hot and dry.

The lowest rate would be in an environment that is humid and cool.

(99) (B). The electron transport chain is a collection of molecules embedded within the cristae membrane of the mitochondrion. It pumps protons from the matrix into the outer compartment to create a steep proton gradient.

(100) (B). The ATP synthase, or ATP synthetase, is a special channel located within the cristae membrane where protons flow down a steep gradient from the outer compartment into the matrix. As protons flow through the ATP synthase channel, they generate energy that is used to phosphorylate ADP into the high-energy ATP. This is the way in which the greatest amount of energy is generated during all of aerobic respiration.

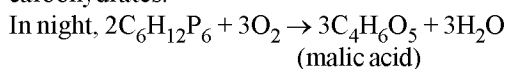
(101) (A). Glycolysis, the breakdown of glucose into pyruvic acid, occurs in the cytoplasm. The pyruvic acid then moves into the matrix of the mitochondrion where the Krebs cycle occurs.

(102) (D). During secondary growth, cells differentiate into xylem and phloem.

(103) (B). Two molecules of ATP are the energy of activation for glycolysis. The other two processes produce ATP.

(104) (D). Carbon dioxide is not used during cell respiration at all; it is given off. It is, however, required for the light-independent reactions of photosynthesis.

(105) (B). In CAM plants stomata open at night. In these plants night acidification occurs. i.e., malic acid is synthesised during night due to incomplete oxidation of carbohydrates.



↓

leads to opening of stomata

At night malic acid formed in guard cells dissociates into  $\text{H}^+$  and malate ions.  $\text{K}^+$  ion exchange from subsidiary cells with  $\text{H}^+$  ions. Thus due to accumulation of  $\text{K}^+$  ions osmotic pressure of guard cells increases, endosmosis occurs and guard cells become turgid due to which stomata opens. The malic acid at day time breaks into  $\text{CO}_2$  and pyruvic acid thus increasing the concentration of  $\text{CO}_2$  in mesophyll cells. This is utilised in Calvin cycle to form sugar which is finally converted into starch.

(106) (B). The propagation through vegetative multiplication is used to maintain the genetic traits of a given plant. It gives rise to genetically uniform population or clone. In case of plants propagated through seeds, variations creep in due to chance segregation of genes during meiosis & their chance combination during fertilization.

(107) (A). According to biological species concept a species is a natural inbreeding or panmictic species or group of natural populations which have essentially similar morphological traits, they are genetically distinct and reproductively isolated from others. Since under laboratory conditions *N. tabacum* can produce self-fertile offspring so they are not reproductively isolated. They are considered as separate species because since their flowering periods are different so cross pollination is not possible between them naturally. This makes them different species.

(108) (D). Photosystem I is located in the nonappressed part of grana thylakoids as well as stroma thylakoids. In this photosystem chlorophyll : carotenoid content is high. Its photocentre is  $\text{P}_{700}$ . Pigment molecules of PSI absorb at or below 700 nm wavelength of light. It receives electrons from photosystem II. Photosystem I is involved in both cyclic and non cyclic photophosphorylation. It is not connected with photolysis of water. Usually it hands over its electron to  $\text{NADP}^+$ .

(109) (D). Plants require many organic and inorganic nutrients to complete their life-cycle. It has been established that some elements are required by plants in relatively large amount and are called major elements or macronutrients, e.g., C, H, O, N, S, P, K, Ca and Mg. Microelements or minor elements or trace elements are required by plants in very small amount, less than 1ppm. E.g., Fe, Cu, B, Zn, Mn, Mo, Cl. Thus Cr is not a micro element.

(110) (D). In facilitated diffusion special proteins help move substances across membranes along the concentration gradient without expenditure of ATP energy. Facilitated

diffusion is very specific, it allows cell to select substances for uptake. It is sensitive to inhibitors which react with protein side chains.

(111) (A).

(112) (A). Cyclic photophosphorylation is performed by photosystem I only. The electron is circulated within the photosystem and the phosphorylation occurs due to cyclic flow of electron. The excited electron does not pass on to  $\text{NADP}^+$  but is cycled back to the PS I complex through the electron transport chain. The cyclic flow hence, results only in the synthesis of ATP, but not of  $\text{NADPH} + \text{H}^+$ .

(113) (A). Calvin pathway occurs in all photosynthetic plants which is  $\text{CO}_2$  fixation cycle. Carbon dioxide combines with ribulose-1, 5-biphosphate to produce a transient intermediate compound. The intermediate compound splits up immediately in the presence of water to form the two molecules of 3-phosphoglycerate or PGA. It is the first stable product of photosynthesis.

(114) (A). After glycolysis, pyruvate forms acetyl Co-A which undergoes oxidation to form  $\text{CO}_2$  and  $\text{H}_2\text{O}$  through Krebs' cycle in mitochondrial matrix.

(115) (C). In active transport, carrier proteins which are located at membrane, use energy in the form of ATP to transport molecules against concentration gradient of cell membrane. Transportation rate reaches maximum when all carrier proteins are being used or are saturated. These proteins are very specific to certain substances and are sensitive to inhibitors.

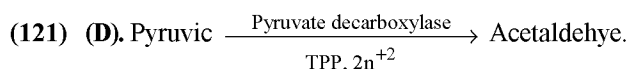
(116) (B).  $\text{C}_4$  plants are more efficient than  $\text{C}_3$  plants because they have little photorespiration while in  $\text{C}_3$  plants more than half of photosynthetic carbon get lost in photorespiration.  $\text{C}_4$  plants are more efficient in picking up  $\text{CO}_2$ , even in low  $\text{CO}_2$  concentration because of high affinity of  $\text{CO}_2$  with PEP (phosphoenol pyruvic acid).

(117) (D)

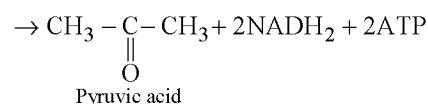
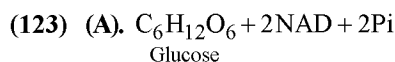
(118) (D)

(119) (C)

(120) (B)



(122) (C). Manganese, Calcium and chloride ions present in PS-II plays an important role in photolysis of water.



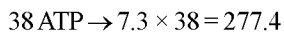
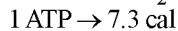
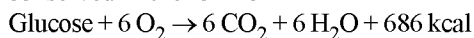
Conversion of glucose into pyruvic acid is glycolysis which is the first step of respiration.

(124) (A). To induce formation of organ in cellus it is necessary to provide growth hormone like Auxin and Cytokinins.

(125) (B). PAR is Photosynthetically active radiation of wavelength ranging from 400-700 nm that is used by green plants for photosynthesis.

(126) (B). The final electron acceptor during ETS in respiration is oxygen.

(127) (B). 40% of energy released during respiration get conserved in the form of ATP

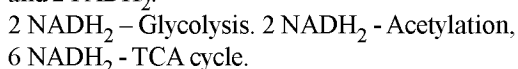


$$\therefore \text{ Total energy conserved} = \frac{277.4}{686} \times 100 = 40.4\%$$

(128) (B). Kalanchoe are example of CAM plants whereas Maize, sugarcane, Jowar are C4 plants.

(129) (A). Plants fix atmospheric carbon through photosynthesis.

(130) (C). The complete oxidation of glucose forms 10 NADH<sub>2</sub> and 2 FADH<sub>2</sub>.



(131) (A). Krebs cycle occurs in the mitochondrial matrix. Cristae and F<sub>1</sub> particles are the site of ETS.

(132) (A). NAA, IBA, and IAA are synthetic auxins which are growth promoters.

(133) (C). Magnesium ion is a common activator of respiratory enzymes

(134) (A).

(135) (B). There is no flow of water into a fully turgid cell as it DPD is zero.

(136) (B). 12 NADPH<sub>2</sub> are used to reduce 12 1,3 bi PGA molecules in Calvin cycle.

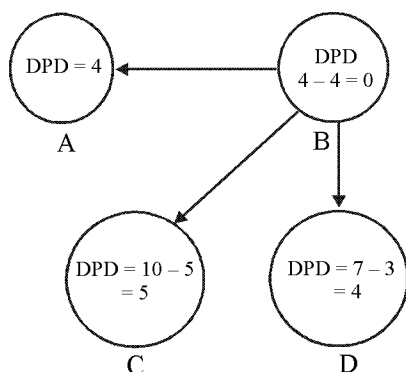
(137) (B). Guttation is the loss of water in the form of liquid drops through water stomata or hydathodes.

(138) (A). Gross primary productivity is the total rate of photosynthesis including the organic matter used up in respiration.

(139) (D). Quantasome - is the site for photophorylation.

(140) (A). Diffusion Pressure Deficit is the value by which the diffusion pressure of a solution is lower than that of pure solvent. It is also known as suction pressure.

$$\text{DPD or SP} = \text{OP} - \text{TP}$$



The movement of water occur from a cell having lower DPD to a cell having higher DPD.

(141) (D). Auxins are generally acidic substances having an unsaturated ring structure. Indole 3-Acetic acid is the

universal natural auxin discovered by Kogl et. al., (1934). Auxin is synthesized in shoot apices, leaf primordia and developing seed from amino acid tryptophan.

The important synthetic auxins are 2, 4-D, 2, 4, 5 T, IBA, NAA, MCPA, etc.

(142) (D).	Opening of Stomata	Closing of Stomata
	Increase in turgidity of guard cell cause opening of stomata.	Due to loss of water from guard cell, the guard cell become flaccid and cause closing of stomata.
	Rise in temperature cause stomatal opening.	Fall in temperature cause stomatal closing.
	Cytokinins required for keeping the stomata open.	Abscisic acid brings about closing of stomata.

(143) (A). **Photoperiodism** is the effect of duration of light and darkness on the growth, development and behaviour of organisms. Such photoperiodic response of red and far-red wavelength is mediated by phytochrome. It is especially connected with flowering of plants.

**Plastocyanin (PC)** is a copper-binding small peripheral protein that is able to diffuse freely along the luminal surface of the thylakoid membrane. It is an electron carrier in photophosphorylation.

**Ferredoxin** is Fe-S protein and used to reduce NADP<sup>+</sup> a reaction mediated by ferredoxin NADP<sup>+</sup> oxidoreductase.

**Cytochrome** is a Fe containing protein used as electron carrier in oxidative phosphorylation.

(144) (B). Cytochromes are proteins with characteristic strong absorption of visible light due to their iron-containing heme prosthetic groups. Mitochondria contain three classes of cytochromes designated a, b and c distinguished by differences in their light absorption spectra. The cytochrome of type a and b and some of type c are integral proteins of inner mitochondrial membrane. The sequence of electron carriers in ETS is NADH → Q → Cyt. b → Cyt. c<sub>1</sub> → Cyt. c → Cyt. a → Cyt. a<sub>3</sub> → O<sub>2</sub>.

(145) (A). In 1967 Hatch and Slack discovered alternative pathway of C<sub>3</sub> cycle for CO<sub>2</sub> fixation called as Hatch and Slack cycle or C<sub>4</sub> cycle. It is found in plants of tropical region (where CO<sub>2</sub> concentration very much reduced). In C<sub>4</sub> plants, the bundle sheath cells of leaf show Kranz anatomy.

Calvin et. al., traced out the path of CO<sub>2</sub> fixation in carbohydrates by using radioisotopes of carbon (C<sup>14</sup>) in alga Chlorella.

Hill (1937) demonstrated that O<sub>2</sub> comes from photolysis of water by chlorophyll activity. Hans Krebs' discovered Krebs' cycle, the main path of glucose oxidation.

(146) (A). Krebs' cycle (TCA or citric acid cycle) was discovered by Hans Krebs. It operates in matrix of mitochondria. The pyruvic acid formed by glycolysis enters into mitochondria and undergo oxidative decarboxylation to produce acetyl Co-A, NADH and CO<sub>2</sub>. Acetyl Co-A is the substrate entrant of Krebs' cycle. In the Krebs' cycle the acetyl Co-A is completely oxidised to CO<sub>2</sub> and H<sub>2</sub>O. The net product from one acetyl Co-A is 12 ATP molecules.

Glycolysis takes place in cytoplasm of the cell. Here one molecule of glucose splits into two molecules of pyruvic acid.

Lysosome contains hydrolytic enzymes.

Nucleus is the control centre of cell. It contains genetic material.

(147) (B). During photosynthesis one Calvin cycle takes is only one carbon (as CO<sub>2</sub>) at a time so, it takes 6 turns of the cycle to produce six carbon compound (glucose). For formation of one molecule of hexose sugar (glucose) 18 ATP and 12 NADPH<sub>2</sub> are used, whereas 30 ATP and 12 NADPH<sub>2</sub> are used during C<sub>4</sub> cycle.

These ATP and NADPH<sub>2</sub> (assimilatory power) are produced during light reaction of photosynthesis.

(148) (D). *Rhizobium* (symbiotic bacterium) occurs in the root nodule of legume plant. Inside the root nodules it develops the ability to fix nitrogen. In root nodule cell bacteria or bacteroids lie in groups and surrounded by membrane of the host cell, which is lined by a pinkish pigment called leghaemoglobin. The enzyme nitrogenase fixes the atmospheric nitrogen. Leghaemoglobin protect the nitrogenase from O<sub>2</sub>.

(149) (A). Shrinkage of the protoplast of a cell from its cell under the influence of hypertonic solution is called **plasmolysis**. Due to plasmolysis the protoplast separates from the cell wall and assumes a spherical form. The space between nucleus and plasma membrane is occupied by hypotonic solution, i.e., like the nature of cell protoplasm as compare to external solution.

(150) (B). Photophosphorylation is a process of ATP formation from ADP with the help of energy of solar radiation. It is of two types

(i) **Cyclic photophosphorylation** : It is the process in which electrons are returned back to the reaction centre. It involves only PS-I.

(ii) **Non-cyclic photophosphorylation** : It is the process in which electron are not returned back to the reaction centre. It involves both PSI and PSII. Here photolysis of H<sub>2</sub>O and release of oxygen take.

(151) (C). We know that the equation of water potential is

$$\psi = \psi_s + \psi_p$$

$\psi$  = Water potential,  $\psi_s$  = Osmotic potential,

$\psi_p$  = Pressure potential

So, according to question the water potential

$$i = -0.9 + 0.5 = -0.4$$

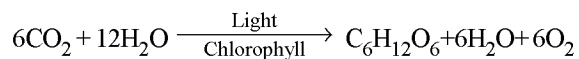
$$ii = -0.8 + 0.6 = -0.2$$

$$iii = -0.6 + 0.1 = -0.5$$

$$iv = -0.7 + 0.4 = -0.3$$

As movement of water is from higher water potential (lower DPD) to lower water potential (higher DPD), hence movement of water is from ii → iv → i → iii

(152) (A). Photosynthesis is the formation of carbohydrates from CO<sub>2</sub> and H<sub>2</sub>O with the help of sunlight in green parts of plants.



Respiration is breakdown of organic food material in presence of O<sub>2</sub> to form CO<sub>2</sub>, water and energy.



(153) (D). Ruben and Kamen (1941) confirmed that source of O<sub>2</sub> is H<sub>2</sub>O and not CO<sub>2</sub>. They used radioisotope of O<sub>2</sub> (O<sup>18</sup>) for this purpose in photosynthesis. The formation of H<sub>2</sub>O and sulphur by photosynthetic bacteria when supplied with H<sub>2</sub>S and CO<sub>2</sub> is also proved the fact.

(154) (D). The auxins in apical bud inhibit the development of lateral buds and the phenomenon is called apical dominance, but it allows apical growth. Recent investigations support that auxins induce the formation of ethylene which acts as inhibitor for lateral buds.

(155) (D). The net gain from complete oxidation of a molecule of glucose in muscles and nerve cells is 36 ATP molecules (10 NADH<sub>2</sub> = 30 ATP, 2 FADH<sub>2</sub> = 4 ATP four formed by substrate level phosphorylation in glycolysis and Krebs' cycle and two consumed in transports of NADH<sub>2</sub> molecules to mitochondria). In aerobic prokaryote, heart, liver and kidney cells 38 ATP molecules are produced per glucose molecule.

(156) (A). Osmosis is the migration of solvent from a hypotonic solution (of lower concentration) to hypertonic solution (of higher concentration) through a semipermeable membrane. The movement of water out of the cell is called exosmosis while movement of water inside cell is called endosmosis.

(157) (D). Certain plants contain abscisic acid which act as growth inhibitor. It promotes abscission of leaves, flowers, fruits and accelerates the senescence of leaves. It is responsible for 50% inhibitions of growth of oat coleoptile.

(158) (D). According to mass flow theory of minerals ions are absorbed by the root along with mass flow of water under the influence of transpiration. However this theory failed to explain the salt accumulations against osmotic gradient.

(159) (B). Due to this pH remains 7 in guard cells. At this pH starch (osmotically inactive) is converted into osmotically active sugar compound. This leads to endosmosis & guard cells move apart. Stomata opens.

(160) (C). In fully turgid plant cell T.P = W.P

(161) (A). Movement of water between cells, takes place along the water potential gradient water moves from a cell having higher water potential to a cell having lower water potential.

Cell B has higher water potential ( $-12 \text{ bars} + 2 \text{ bars} = -10 \text{ bars}$ ) where as cell A has lower water potential ( $-20 \text{ bars} + 8 \text{ bars} = -12 \text{ bars}$ ).

Hence water moves from cell B to cell A

- (162) (B). Loss of water by transpiration through leaves results in development highly negative water potential in leaf cells or a suction force called transpiration pull. This helps in passive absorption of water by roots.
- (163) (C). Guttation seen only in mesophytic plants during night and early morning.
- (164) (A). Pull or suction is called transpiration pull.
- (165) (D). Increasing the solute concentration in the guard cells. As the solute concentration increases, the water potential becomes less negative. Hence the cell undergoes endosmosis. This results in the turgidity and opening of stomata.
- (166) (B). Passage cells are the transfusion cells of the endodermis of monocot root.
- (167) (A). Mesophyll cells to sieve tubes.  
It requires  $H^+$  ATPase and sucrose symporter.
- (168) (B). i.e. Hypertonic solution

(169) (C).

(170) (C). Because it takes place in matrix  
But answer can be (D)

(171) (D).

(172) (C). It catalyses fixation of  $CO_2$  by phosphoenolpyruvic acid and formation of Oxaloacetic acid in  $C_4$  Cycle.

(173) (D).

Two photosystems participate.

ATP and NADPH are produced.

(174) (C). Conversion of pyruvate to acetyl CoA

-Preparatory phase of Krebs's cycle

(175) (B). Synthesis of ATP

(176) (A). Pineapple

(177) (C). - Two

Gross ATP production = 04

2 ATP are used in the initial process of glycolysis.

Therefore  $4 - 2 = 02$

(178) (A). These protons move from intermembrane space to matrix through  $F_0F_1$  particle.

(179) (A).

(180) (B).