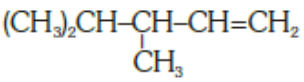
AIPMT 2015

Chemistry

1. 2,3–Dimethyl–2–butene can be prepared by heating which of the following compounds with a strong acid ?

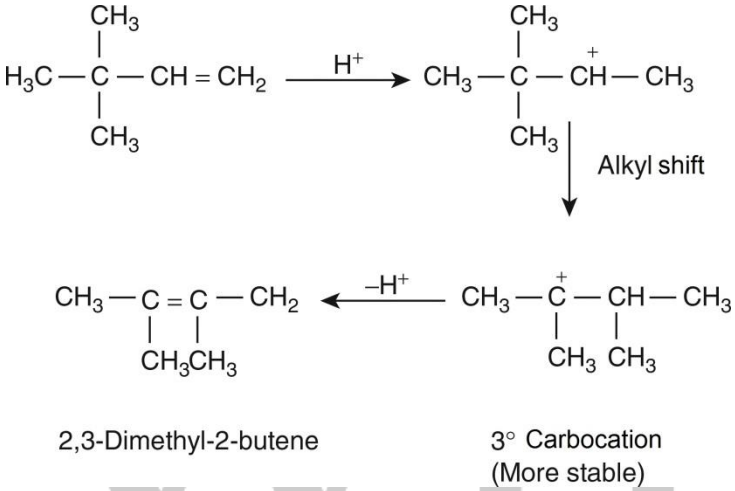
(1) $(CH_3)_2C=CH-CH_2-CH_3$ (2) $(CH_3)_2CH-CH_2-CH=CH_2$



(3) (4) $(CH_3)_3C-CH=CH_2$

Solution:

On heating 3, 3-Dimethyl-2-butene in the presence of strong acid gives 2, 3-dimethyl-2-butene.



Hence, the correct option is (4).

2. Gadolinium belongs to 4*f* series. It's atomic number is 64. Which of the following is the correct electronic configuration of gadolinium?

(1) $[Xe]4f^7 5d^1 6s^2$ (2) $[Xe]4f^6 5d^2 6s^2$

(3) $[Xe]4f^8 6d^2$ (4) $[Xe]4f^9 5s^1$

Solution:

The correct electronic configuration of

$_{64}Gd = {}_{54}[Xe]4f^7 5d^1 6s^2$

Hence, the correct option is (1).

3. The formation of the oxide ion, $O^{2-}(g)$, from oxygen atom requires first an exothermic and then an endothermic step as shown below:

$O(g) + e^- \rightarrow O^-(g)$; $\Delta_f H = -141$ kJ mol^{-1}

$O^-(g) + e^- \rightarrow O^{2-}(g)$; $\Delta_f H = +780$ kJ mol^{-1}

Thus, process of formation of O^{2-} in gas phase is unfavorable even though O^{2-} is isoelectronic with neon. It is due to the fact that,

(1) Oxygen is more electronegative

(2) Addition of electron in oxygen results in larger size of the ion

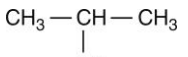
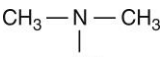
(3) Electron repulsion outweighs the stability gained by achieving noble gas configuration

(4) O^- ion has comparatively smaller size than oxygen atom.

Solution:
Electron repulsion outweighs the stability gained by achieving noble gas configuration.
Hence, the correct option is (3).

4. The number of structural isomers possible from the molecular formula C_3H_9N is:
(1) 2 (2) 3
(3) 4 (4) 5

Solution:
There are four structural isomers possible for molecule C_3H_9N. The structures are:

$CH_3-CH_2-CH_2-NH_2$, $CH_3-CH_2-NH-CH_3$,  and 
Hence, the correct option is (3).

5. If the equilibrium constant for:
$N_2(g)+O_2(g) \rightleftharpoons 2NO(g)$ is K, the equilibrium constant for $\frac{1}{2}N_2(g)+\frac{1}{2}O_2(g) \rightleftharpoons NO(g)$ will be:
(1) K (2) K^2
(3) $K^{1/2}$ (4) ½K

Solution:
$N_2(g)+O_2(g) \rightleftharpoons 2NO(g); K$
On multiplying ½ both the sides of reaction, we get
$\frac{1}{2}N_2(g)+\frac{1}{2}O_2(g) \rightleftharpoons NO(g)$
Let the equilibrium constant for the above reaction be K'.
Then, $K' = (K)^{1/2}$
Hence, the correct option is (3).

6. Which one of the following pairs of Solution: is not an acidic buffer?
(1) H_2CO_3 and Na_2CO_3
(2) H_3PO_4 and Na_3PO_4
(3) $HClO_4$ and $NaClO_4$
(4) CH_3COOH and CH_3COONa

Solution:
The Solution: of $HClO_4$ and $NaClO_4$ can act as acidic buffer.
Hence, the correct option is (3).

7. Aqueous Solution: of which of the following compounds is the best conductor of electric current?
(1) Ammonia, NH_3 (2) Fructose, $C_6H_{12}O_6$
(3) Acetic acid, $C_2H_4O_2$ (4) Hydrochloric acid, HCl

Solution:
HCl is a strong acid. It dissociates completely into ions. Thus, the aqueous Solution: of HCl is a best conductor of electricity.
Hence, the correct option is (3).

8. Caprolactam is used for the manufacture of:
(1) Terylene (2) Nylon - 6, 6
(3) Nylon - 6 (4) Teflon

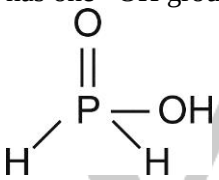
Solution:
Caprolactum is the monomer unit of Nylon-6.
Hence, the correct option is (3).

9. On heating which of the following releases CO_2 most easily?
(1) $MgCO_3$ (2) $CaCO_3$
(3) K_2CO_3 (4) Na_2CO_3

Solution:
Among the given compounds, magnesium carbonate is least stable hence it dissociates readily and releases CO_2.
$MgCO_3 \xrightarrow{\Delta} MgO + CO_2 \uparrow$
Hence, the correct option is (1).

10. Strong reducing behavior of H_3PO_2 is due to:
(1) High oxidation state of phosphorus
(2) Presence of two –OH groups and one P – H bond
(3) Presence of one –OH group and two P – H bonds
(4) High electron gain enthalpy of phosphorus

Solution: All oxy-acid of phosphorus which contain P – H bond act as reductant. H_3PO_2 as its structure suggests has one –OH group and two P – H bonds.



Hence, the correct option is (3).

11. Decreasing order of stability of O_2, O_2^-, O_2^+ and O_2^{2-} is:
(1) $O_2 > O_2^+ > O_2^{2-} > O_2^-$ (2) $O_2^- > O_2^{2-} > O_2^+ > O_2$
(3) $O_2^+ > O_2 > O_2^- > O_2^{2-}$ (4) $O_2^{2-} > O_2^- > O_2 > O_2^+$

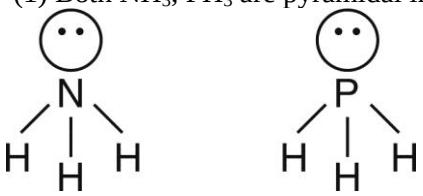
Solution:
The stability of a given species is directly proportional to its bond order. Higher is the bond orders, greater is its stability. The bond order of O_2^+, O_2, O_2^- are 2.5, 2, 1.5 and 1 respectively. Thus, the stability order is $O_2^+ > O_2 > O_2^- > O_2^{2-}$
Hence, the correct option is (3).

12. The number of water molecules is maximum in:
(1) 18 gram of water (2) 18 moles of water
(3) 18 molecules of water (4) 1.8 gram of water

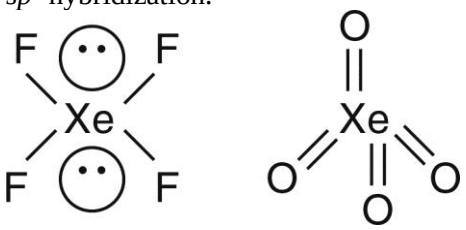
Solution:
1 mol of water contains 6.02×10^{23} molecules. Therefore, 18 mol water contains = $18 \times 6.02 \times 10^{23}$ molecules
Hence, the correct option is (2).

13. In which of the following pairs, both the species are not isostructural ?
(1) NH_3, PH_3 (2) XeF_4, XeO_4
(3) $SiCl_4$, PCl_4 (4) Diamond, silicon carbide
Solution:

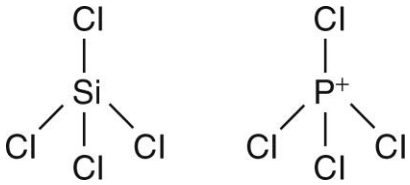
(1) Both NH_3, PH_3 are pyramidal in shape.



(2) The structure of XeF_4 is square planar with hybridization sp^3d^2, while the structure of XeO_4 is tetrahedral with sp^3 hybridization.

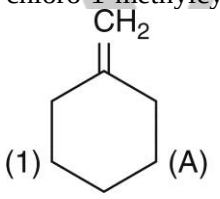


(3) Both $SiCl_4$, PCl_4^+ are tetrahedral in shape.

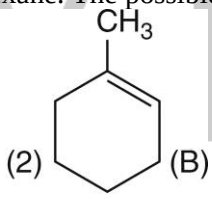


Hence, the correct option is (2).

14. In the reaction with HCl, an alkene reacts in accordance with the Markovnikov's rule, to give a product 1-chloro-1-methylcyclohexane. The possible alkene is:

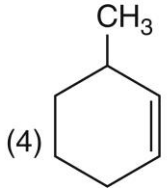


(1) (A)



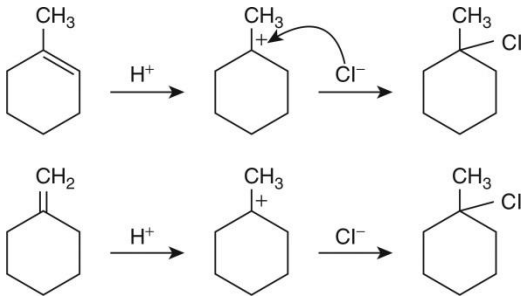
(2) (B)

(3) (A) and (B)



(4)

Solution:



Hence, the correct option is (3).

15. Assuming complete ionization, same moles of which of the following compounds will require the least amount of acidified $KMnO_4$ for complete oxidation?

(1) FeC_2O_4 (2) $Fe(NO_2)_2$

(3) $FeSO_4$ (4) $FeSO_3$

Solution:

$FeSO_4$ will require the least amount of acidified $KMnO_4$ for complete oxidation.

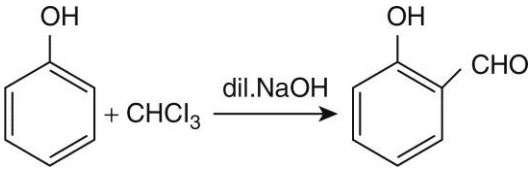
Hence, the correct option is (3).

16. Reaction of phenol with chloroform in presence of dilute sodium hydroxide finally introduces which one of the following functional group ?

(1) $-CHCl_2$ (2) –CHO

(3) $-CH_2Cl$ (4) –COOH

Solution:



This is Reimer Tieman reaction.

Hence, the correct option is (2).

17. The vacant space in bcc lattice unit cell is:

(1) 23% (2) 32%

(3) 26% (4) 48%

Solution:

Packing efficiency in bcc lattice = 68%

$\therefore$ vacant space in bcc lattice = 100 – 68 = 32%

Hence, the correct option is (2).

18. Which of the statements given below is incorrect?

(1) ONF is isoelectronic with O_2N^-– (2) OF_2 is an oxide of fluorine

(3) Cl_2O_7 is an anhydride of perchloric acid (4) O_3 molecule is bent

Solution:

(1) Both ONF and O_2N^- are isoelectronic to each other as both the species contain 24 electrons.

(2) The electron negativity of fluorine is more than that of oxygen. Hence, OF is a fluoride of oxygen.

(3) Cl_2O_7 is an anhydride of perchloric acid.

(4) Ozone (O_3) bent shape

Hence, the correct option is (2).

19. The name of complex ion, $[Fe(CN)_6]^{3-}$ is:

(1) Tricyanoferrate (III) ion (2) Hexacyanidoferrate (III) ion

(3) Hexacyanoiron (III) ion (4) Hexacyanitoferrate (III) ion

Solution:

The name of the complexion is Hexacyanidoferrate (III) ion.

Hence, the correct option is (2).

20. If Avogadro number N_A, is changed from 6.022×10^{23} mol^{-1} to 6.022×10^{20} mol^{-1}, this would change:

(1) the ratio of chemical species to each other in a balanced equation.
(2) the ratio of elements to each other in a compound.
(3) the definition of mass in units of grams.
(4) the mass of one mole of carbon.

Solution:
12g of carbon = 6.022×10^{23} atoms (mass of 1 mol)

Mass of 1 mol of carbon $= \frac{12 \times 6.022 \times 10^{20}}{6.022 \times 10^{23}}$

$= 12 \times 10^{-3}$g

Hence, the correct option is (4).

21. Which of the following statements is not correct for a nucleophile?
(1) Nucleophiles attack low e^- density sites. (2) Nucleophiles are not electron seeking.
(3) Nucleophile is a Lewis acid. (4) Ammonia is a nucleophile.

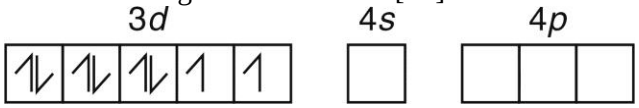
Solution:
Nucleophiles are electron rich species this act as Lewis base. Lenis acids are electron-deficient species.
Hence, the correct option is (3).

22. A gas such as carbon monoxide would be most likely to obey the ideal gas law at:
(1) high temperatures and high pressures (2) low temperatures and low pressures
(3) high temperatures and low pressures (4) low temperatures and high pressures

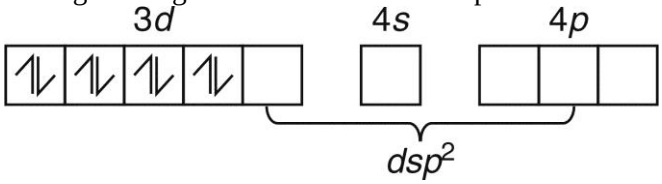
Solution:
Carbon monoxide will show ideal gas behavior at high temperatures and low pressure.
Hence, the correct option is (3).

23. The hybridization involved in complex $[Ni(CN)_4]^{2-}$ is (At.no. of Ni = 28)
(1) d^2sp^2 (2) d^2sp^3
(3) dsp^2 (4) sp^3

Solution:
In $[Ni(CN)_4]^{2-}$, oxidation state of Ni is +2.
$\therefore$ The electronic configuration of $Ni^{2+} = [Ar]^{18}3d^8 4s°$



CN^- is a strong field ligand due which all the unpaired electrons are paired up.



Hence, the correct option is (3).

24. The heat of combustion of carbon to CO_2 is – 393.5 kJ/mol. The heat released upon formation of 35.2 g of CO_2 from carbon and oxygen gas is:
(1) –630 kJ (2) –3.15 kJ
(3) –315 kJ (4) +315 kJ

Solution:
$C(s) + O_2(g) \rightarrow CO_2(g)$; $\Delta_f H = -393.5$ kJ mol^{-1}
Heat released due to formation of 44g of $CO_2 = -393.5$ kJ mol^{-1}
Heat released due to formation of 35.2g of $CO_2 = \frac{-393.5}{44} \times 35.2 = -315$ kJ

Hence, the correct option is (3).

25. 20.0 g of a magnesium carbonate sample decomposes on heating to give carbon dioxide and 8.0g magnesium oxide. What will be the percentage purity of magnesium carbonate in the sample?
(1) 60 (2) 84
(3) 75 (4) 96

Solution:
The decomposition reaction is
$$MgCO_3 \xrightarrow{\Delta} MgO + CO_2$$
Number of notes of $MgCO_3 = \frac{20}{84} = 0.238$ mol
Since, 1 mol of $MgCO_3$ gives 1 mol of MgO
$\therefore$ 0.238 mol of $MgCO_3$ will give 0.238 mol of MgO
$= 0.238 \times 40g = 9.52g$ MgO
Yield obtained = 80g
$$\% = \frac{\text{Experimental yield}}{\text{Theoretical yield}} \times 100$$
$$= \frac{8}{9.523} \times 100 = 84\%$$
Hence, the correct option is (2).

26. What is the mole fraction of the solute in a 1.00 m aqueous Solution:?
(1) 0.0354 (2) 0.0177
(3) 0.177 (4) 1.770

Solution:
Number of moles of water $= \frac{1000}{8} = 55.5$ mol/H_2O
$$X_{solute} = \frac{n_{solute}}{n_{solute} + n_{H_2O}} = \frac{1}{1+55.5} = 0.0177$$
Hence, the correct option is (2).

27. The correct statement regarding defects in crystalline solids is:
(1) Frenkel defect is a dislocation defect
(2) Frenkel defect is found in hallides of alkaline metals
(3) Schottky defects have no effect on the density of crystalline solids
(4) Frenkel defects decrease the density of crystalline solids

Solution:
Frenkel defect is a dislocation defect.
Hence, the correct option is (1).

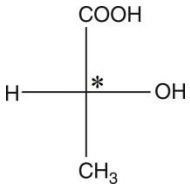
28. The stability of +1 oxidation state among Al, Ga, In and TI increases in the sequence:

(1) TI < In < Ga < Al
(2) In < TI < Ga < Al
(3) Ga < In < Al < TI
(4) Al < Ga < In < TI

Solution:
The stability of H oxidation state is
Al < Ga < In < Tl
Hence, the correct option is (4).

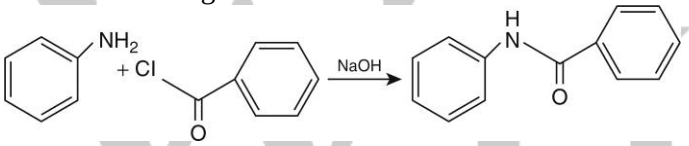
29. Two possible stereo-structures of $CH_3CHOH.COOH$, which are optically active, are called:
(1) Enantiomers
(2) Mesomers
(3) Diastereomers
(4) Atropisomers

Solution:



There is one chiral center in the molecule. Thus, two optically active enantiomers are possible.
Hence, the correct option is (1).

30. The following reaction:



is known by the name :
(1) Acetylation reaction
(2) Schotten-Baumen reaction
(3) Friedel Craft's reaction
(4) Perkin's reaction

Solution:
The given reaction is an example of Schotten – Baumen reaction.
Hence, the correct option is (2).

31. The sum of coordination number and oxidation number of the metal M in the complex $[M(en)_2(C_2O_4)]Cl$ (where en is ethylenediamine) is:
(1) 7
(2) 8
(3) 9
(4) 6

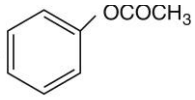
Solution:
The oxidation state of M = 3
Coordination number = 6
$\therefore$ Sum = 3 + 6 = 9
Hence, the correct option is (3).

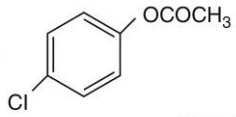
32. Reaction of carbonyl compound with one of the following reagents involves nucleophilic addition followed by elimination of water. The reagent is:
(1) hydrocyanic acid
(2) sodium hydrogen sulphite
(3) a Grignard reagent
(4) hydrazine in presence of feebly acidic Solution:

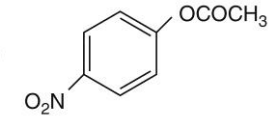
Solution:

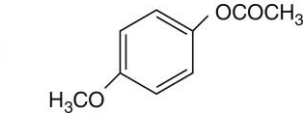
Carbonyl compounds undergo nucleophilic addition elimination reaction with ammonia and its derivative.
Hence, the correct option is (4).

33. Which one of the following esters gets hydrolysed most easily under alkaline conditions?

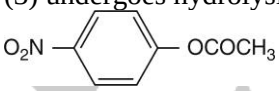
(1) 

(2) 

(3) 

(4) 

Solution:
(3) undergoes hydrolysis most easily due to the presence of electron withdrawing – NO_2 group.



Hence, the correct option is (3).

34. In an S_N1 reaction on chiral centers, there is:
(1) 100% retention (2) 100% inversion
(3) 100% racemization (4) inversion more than retention leading to partial racemization

Solution:
S_N1 reaction is a two-step process. Carbocations formed undergo rearrangement also susceptible to attack by nucleophile from any side depending on steric factors. Thus, it leads to the formation of racemic mixture with some amount of the formation of isomer corresponds to inversion.
Hence, the correct option is (4).

35. The rate constant of the reaction A $\rightarrow$ B is 0.6×10^{-3} mole per second. If the concentration of A is 5 M, then concentration of B after 20 minutes is:
(1) 0.36 M (2) 0.72 M
(3) 1.08 M (4) 3.60 M

Solution:
For zero-order reaction
$c = kt$
where c is the concentration, k is rate constant and t is time.
$c = (0.6 \times 10^{-3} \text{ mol s}^{-1}) \times 20 \times 60\text{s}$
$= 0.72$ M
Hence, the correct option is (2).

36. What is the pH of the resulting Solution: when equal volumes of 0.1 M NaOH and 0.01 M HCl are mixed?
(1) 7.0 (2) 1.04
(3) 12.65 (4) 2.0

Solution:

$MV = M_1V_1 - M_2V_2$
$MX_2 = 0.1 \times 1 - 0.01 \times 1$

$$[OH^-] = M = \frac{0.09}{2} = 0.045\ M$$

$pOH = -\log [OH^-] = -\log (0.045) = 1.35$
$\because$ pH + pOH = 14
$\therefore$ pH = 14 – 1.35 = 12.65
Hence, the correct option is (3).

37. Number of possible isomers for the complex $[Co(en)_2Cl_2]$ Cl will be: (en = ethylenediamine)
(1) 3 (2) 4
(3) 2 (4) 1
Solution:
The total number of possible stereoisomers for the complex of type $[M(AA)_2a_2]$ is three.
Hence, the correct option is (1).

38. The variation of the boiling points of the hydrogen halides is in the order HF > HI > HBr > HCl. What explains the higher boiling point of hydrogen fluoride?
(1) The bond energy of HF molecules is greater than in other hydrogen halides.
(2) The effect of nuclear shielding is much reduced in fluorine which polarizes the HF molecule.
(3) The electronegativity of fluorine is much higher than for other elements in the group.
(4) There is strong hydrogen bonding between HF molecules.

Solution:
Hydrogen bonding is strongest in case of HF followed by HI, HBr and HCl.
Hence, the correct option is (4).

39. What is the mass of the precipitate formed when 50 mL of 16.9% Solution: of $AgNO_3$ is mixed with 50 mL of 5.8% NaCl Solution:? (Ag = 107.8, N = 14, O = 16, Na = 23, Cl =35.5)
(1) 7 g (2) 14 g
(3) 28 g (4) 3.5 g

Solution:
16.9% Solution: of $AgNO_3$ implies that 8.45g of $AgNO_3$ is present in 50 mL Solution:.
Similarly, 5.8% of NaCl indicates 2.9g of NaCl is present in 50 mL Solution:.

$$\text{No. of moles of } AgNO_3 = \frac{8.45\text{g}}{170\ \text{g/mol}} = 0.049\ \text{mol}$$

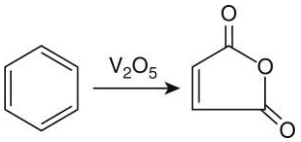
$$\text{No. of moles of NaCl} = \frac{2.9\ \text{g}}{58.5\ \text{g/mol}} = 0.049\ \text{mol}$$

The reaction is:	$AgNO_3$	+ NaCl	$\rightarrow$	AgCl	+	$NaNO_3$
Initial amount	0.049	0.049		0		0
Final amount	0	0		0.049		0.049

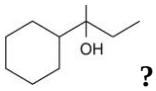
$\therefore$ Mass of AgCl precipitated = 0.049 mol × 143.5 g/mol
= 7 g
Hence, the correct option is (1).

40. The oxidation of benzene by V_2O_5 in the presence of air produces:
(1) benzoic acid (2) benzaldehyde
(3) benzoic anhydride (4) maleic anhydride

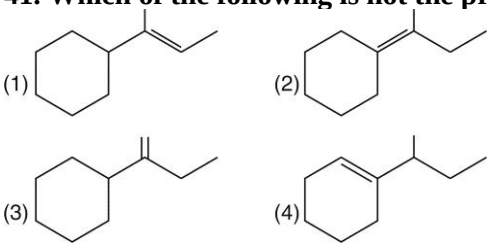
Solution:
The oxidation of benzene by V_2O_5 in the presence of air produces malic anhydride:



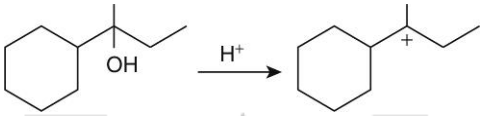
Hence, the correct option is (4).

41. Which of the following is not the product of dehydration of 

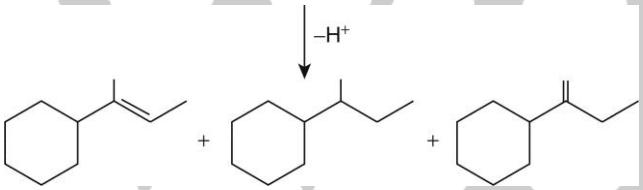
?



Solution:



(Formation of 3° carbocation)



Hence, the correct option is (4).

42. Method by which aniline cannot be prepared is:
(1) reduction of nitrobenzene with H_2/Pd in ethanol
(2) potassium salt of phthalimide treated with chlorobenzene followed by hydrolysis with aqueous NaOH Solution:
(3) hydrolysis of phenylisocyanide with acidic Solution:
(4) degradation of benzamide with bromine in alkaline Solution:

Solution:
The double bond character of C-Cl bond in chlorobenzene due to resonance would not lead to the formation of aniline.
Hence, the correct option is (2).

43. Which of the following reaction(s) can be used for the preparation of alkyl halides ?
(I) $CH_3CH_2OH + HCl \xrightarrow{anh.\ ZnCl_2}$
(II) $CH_3CH_2OH + HCl \longrightarrow$
(III) $(CH_3)_3COH + HCl \longrightarrow$
(IV) $(CH_3)_2CHOH + HCl \xrightarrow{anh.\ ZnCl_2}$
(1) (IV) only
(2) (III) and (IV) only
(3) (I), (III) and (IV) only
(4) (I) and (II) only

Solution:
As (I) and (IV) involves the formation of more stable carbocation in the presence of anhydrous $ZnCl_2$. (III) gives alkyl halide due to formation of more stable carbocation.
Hence, the correct option is (3).

44. Which is the correct order of increasing energy of the listed orbitals in the atom of titanium? (At. no. of Z = 22)
(1) 3*s* 3*p* 3*d* 4*s* (2) 3*s* 3*p* 4*s* 3*d*
(3) 3*s* 4*s* 3*p* 3*d* (4) 4*s* 3*s* 3*p* 3*d*

Solution:
The electronic configuration of Ti is
$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^2$
Therefore, the order of energy is = $3s < 3p^2 < 4s < 4d$
Hence, the correct option is (2).

45. In the extraction of copper from its sulphide ore, the metal is finally obtained by the reduction of cuprous oxide with
(1) copper(I) sulphide (2) sulphur dioxide
(3) iron(II) sulphide (4) carbon monoxide

Solution:
This is self-reduction.
$Cu_2S + 2Cu_2O \rightarrow 6Cu + SO_2 \uparrow$
Hence, the correct option is (3).