2019/EVEN/08/22/CHM–203/204

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PG Even Semester (CBCS) Exam., May—2019

CHEMISTRY

(2nd Semester)

Course No. : CHMOC–203

(General Chemistry)

Full Marks : 70
Pass Marks : 28

Time : 3 hours

The figures in the margin indicate full marks for the questions

Answer **five** questions, selecting **one** from each Unit

UNIT—I

1. *(a)* Furnish the MO diagram of CO. Using the MO concept, deduce the bond order and number of unpaired electron(s) in the molecule. 3+4=7

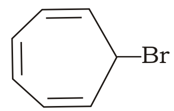
(b) Distinguish between symmetry element and symmetry operation giving a suitable example. Work out the point group of *(i)* O_2, *(ii)* CO_2, *(iii)* $CHCl_3$ and *(iv)* NO_3. 3+4=7

2. *(a)* CH_4 is tetrahedral, whereas C_2H_2 and C_2H_4 are planner. Why? 3

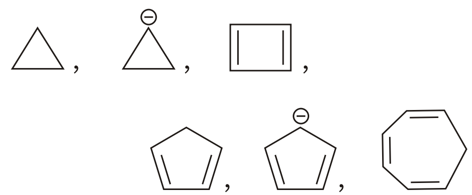
(b) What is resonance and resonance energy? The actual heat of atomization of benzene is 1323 kcal/mole, energy of C═C bond of cyclohexene is 148·8 kcal/mole, C—C bond of cyclohexane is 81·8 kcal/mole and C—H bond for CH_4 is 99·5 kcal/mole. Calculate the resonance energy of benzene. 3

(c) Draw different canonical forms of aniline and phenol. 1½×2=3

(d) Explain why tropylium bromide (*A*) is ionic and not a covalent compound : 2

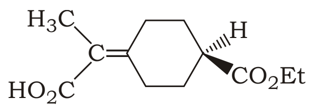


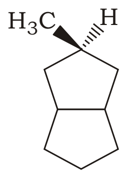
(e) Classify the following species as aromatic / anti-aromatic / non-aromatic with brief explanations : 3

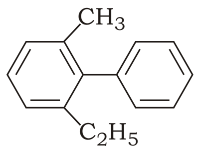


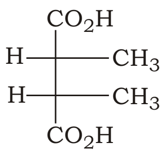
UNIT—II

3. *(a)* From the following, identify which are optically resolvable. Give reason for your observation in brief : 4

(i) 

(ii) 

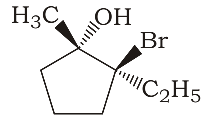
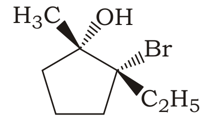
(iii) 

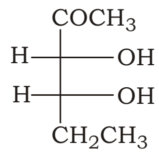
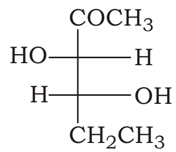
(iv) 

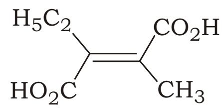
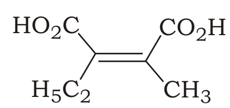
(b) What is asymmetric synthesis? Outline the aspects of chiral pool with an example to describe the process. 1+5=6

(c) Provide various stereoisomers of $HO_2C—CH(Br)—CH(Br)—CO_2Me$ and identify them as pairs of enantiomers or/and diastereomers. 4

4. *(a)* Identify the following pairs of stereo-isomers as identical/enantiomers/diastereomers by assigning the priority rule, etc. : 2×3=6

(i)  and 

(ii)  and 

(iii)  and 

(b) Describe the differences between the following with an example for each : 2×2=4

(i) Conformers and configurational isomers

(ii) *Meso*-compound and racemic mixture

(c) Mention various methods for asymmetric synthesis and also indicate their advantages and disadvantages. 3

(d) "Stereogenic carbons are not the only criteria for optical activity." Justify the statement. 1

UNIT—III

5. *(a)* "Increase in the polarity of the solvent shifts * bond to longer wavelength but *n* * and *n* * bond to shorter wavelength." Comment on the statement. 3

(b) Define the following terms : 3

(i) Bathochromic shift

(ii) Hypsochromic shift

(iii) Chromophore

(c) How will you distinguish the following pairs of compounds with the help of IR spectrum? 2×2=4

(i) H_3CCH_2OH and $H_3C{-}CH_2{-}\overset{\overset{\displaystyle O}{\|}}{C}{-}OH$

(ii) $H_3CCH_2{-}\overset{\overset{\displaystyle O}{\|}}{C}{-}H$ and $H_2C{=}CH{-}\overset{\overset{\displaystyle O}{\|}}{C}{-}H$

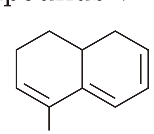
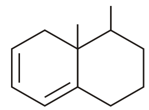
(d) Write short notes on the following : 2×2=4

(i) Chemical shift

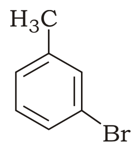
(ii) Spin-spin coupling

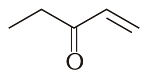
6. *(a)* "The wavelength as well as the extinction coefficient increases with increase in conjugation." Justify the statement. 3

(b) Calculate $_{max}$ for the following compounds : 1½×2=3

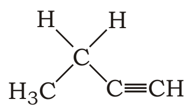
 and 

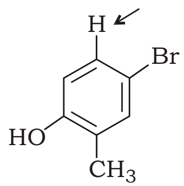
(c) How many signals would you expect in PMR spectra of the following compounds? 2

(i) 

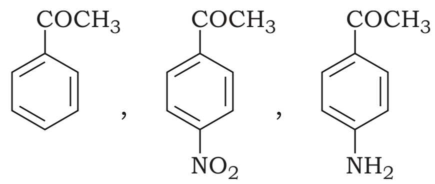
(ii) 

(d) Show the splitting pattern of the marked proton in the PMR spectra : 2

(i) 

(ii) 

(e) Arrange the following compounds in order of increasing C=O in IR spectrum. Provide explanations for your observation : 1+3=4

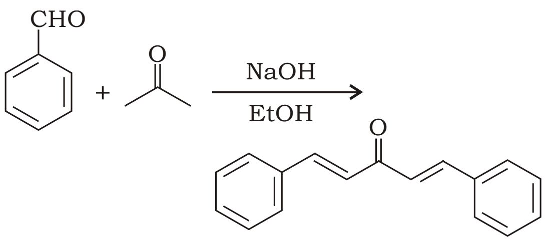


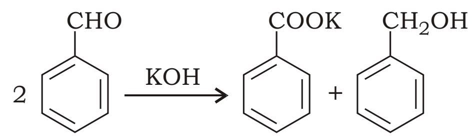
UNIT—IV

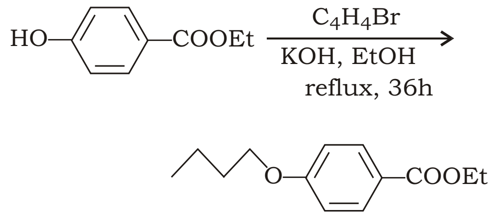
7. (a) How can a chemical process be made more energy efficient? 1

(b) What are the twelve principles of green chemistry? 4

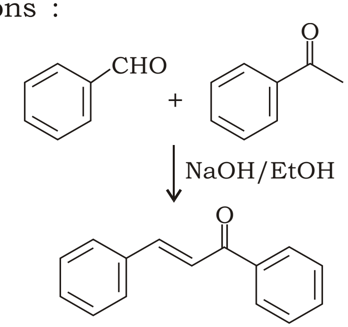
(c) Suggest green alternatives for the following reactions with justification for your proposed processes : (1+2)×3=9

(i) 

(ii) 

(iii) 

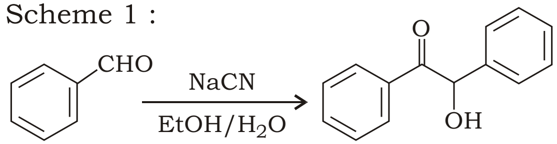
8. (a) What is atom economy? Calculate the atom economy of the following reactions : 1+2=3



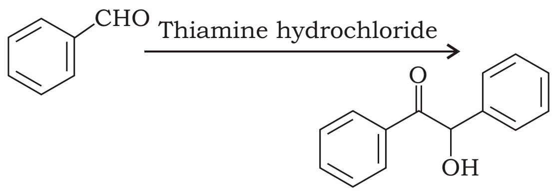
(b) Provide the traditional route and greener route for the synthesis of adipic acid. Provide comparison between the two in the light of green chemical concepts. 2+2=4

(c) Identify the Greener process among the following reactions. Provide justification : (1+2)×2=6

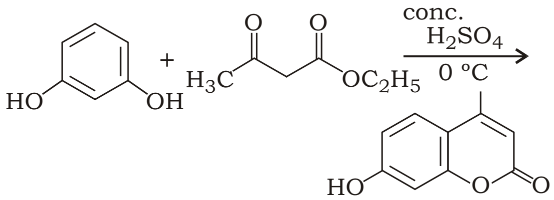
(i) Scheme 1 :



Scheme 2 :



(ii) Scheme 1 :



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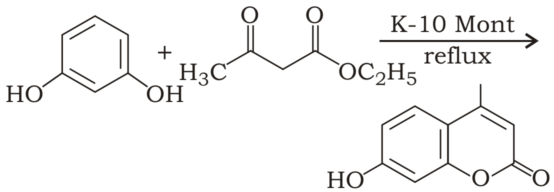

(d) How can green chemistry concepts be helpful for the sustainability of industrial processes? 1

UNIT—V

9. *(a)* Define nanoscale materials. Why are they interesting? What are intrinsic and extrinsic size effects? 1+2+2=5

(b) Describe various classifications of nanomaterials based on their dimensions. 3

(c) Write the effects of nanosize on internal properties. Mention different characterization techniques of nanomaterials. 2+1=3

(d) Write a short note on quantum dots. 3

10. *(a)* What are magnetic nanostructures? Mention the consequences that arises due to 'nano' only structures. How do they show superparamagnetism? 1+2+2=5

(b) Describe the application of nanotechnology in cancer treatments. 4

(c) What are solar cells? Describe the applications of nanoparticles in solar cells. 2+3=5

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