II.1 Delocalised Covalent Bonding

Civil Services 2016–2026: **17** parts, **155** marks · IFoS 2016–2025: **24** parts, **135** marks

Syllabus. Aromaticity, anti-aromaticity; annulenes, azulenes, tropolones, fulvenes, sydnones.

Marks	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
CSE	20	20	20	25	0	15	10	15	10	10	10
IFoS	25	30	10	5	10	20	10	5	10	10	

How to use this chapter. Read every question once and mark the ones that repeat. Pick three, write them by hand against the clock (about 7 minutes for 10 marks), then compare with the model answers on vkcscience.com.

2026

CSE 2026 · Q1(a) [10]Annulene isomers; sydnone and tropolone [10 marks]

(i) Draw the structures of three possible geometrical isomers of [10] annulene and explain the aromaticity.

(ii) Explain the aromaticity of sydnone and tropolone.

2025

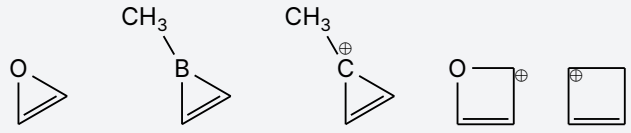
CSE 2025 · Q1(a) Tropolone, fulvene and pseudo-aromaticity [10 marks]

(i) Tropolone is aromatic, but fulvene is non-aromatic. Why?

(ii) Explain with example pseudo-aromaticity.

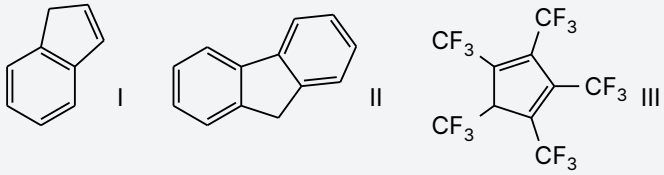
IFoS 2025 · Q1(a) Aromaticity of small rings [5 marks]

Based on Huckel's rule of aromaticity, identify the following species as aromatic, antiaromatic, and nonaromatic :



IFoS 2025 · Q4(c)(i) Acidity and aromatic conjugate bases [5 marks]

(i) Arrange the following compounds in order of their decreasing acidity and give suitable justification :

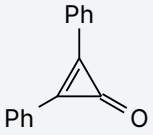


2024

CSE 2024 · Q1(a) Aromatic, non-aromatic or antiaromatic; Diphenylcyclopropenone resists nucleophilic addition [10 marks]

(i) Classify the following as aromatic, nonaromatic or antiaromatic:
(1) Azulene (2) Pyridine (3) Sydnone (4) Cyclooctatetraene (5) Cyclopentadienyl cation 5

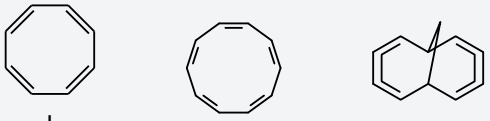
(ii) Though the following compound contains a keto group, it does not undergo nucleophilic addition reactions. Explain:



5

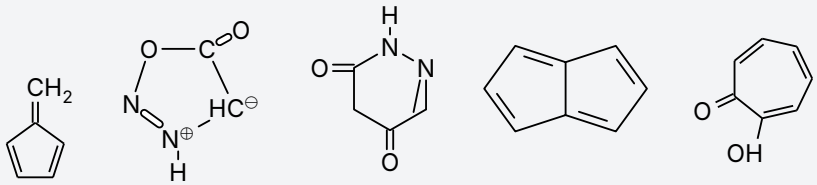
IFoS 2024 · Q1(a) Annulenes and aromaticity [5 marks]

Which one of the following is aromatic? Justify your answer. Give names of the given annulenes :



IFoS 2024 · Q1(c) Five aromaticity decisions [5 marks]

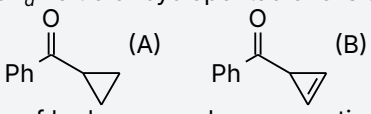
Comment on aromatic/non-aromatic/anti-aromatic behaviour of the following compounds and justify your answer :



2023

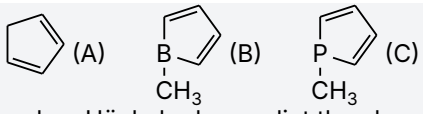
CSE 2023 · Q1(a) Acidity of cyclopentadiene; Hydrogen exchange in cyclopropyl and cyclopropenyl ketones [10 marks]

(i) pK_a value of cyclopentadiene is almost similar to water. Explain. (5 marks)

(ii) 

Rate of hydrogen exchange reaction in the above compound (A) is 6000 times faster than that of (B). Explain. (5 marks)

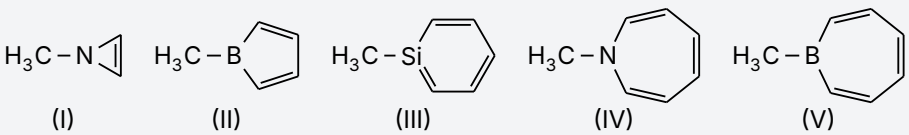
CSE 2023 · Q2(a)(i) Aromatic, antiaromatic or non-aromatic by the Hückel rule [5 marks]

(i) 

Based on Hückel rule, predict the above compounds as aromatic, antiaromatic, and nonaromatic. (5 marks)

IFoS 2023 · Q1(a) Aromaticity of heterocycles [5 marks]

On the basis of Huckel's Rules of aromaticity, identify the following compounds as aromatic, antiaromatic and non-aromatic :



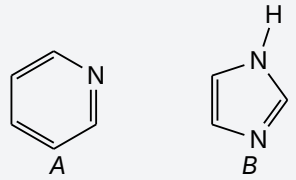
2022

CSE 2022 · Q1(a) Ionisation of 3,4-dichloro-1,2,3,4-tetramethylcyclobutene in SbF_5–SO_2 [10 marks]

Ionization of 3,4-dichloro-1,2,3,4-tetramethylcyclobutene in SbF_5-SO_2 at −75 °C produces a reaction intermediate of its own kind. Predict the intermediate and comment on its stability and aromaticity.

IFoS 2022 · Q1(a) Pyridine versus imidazole [5 marks]

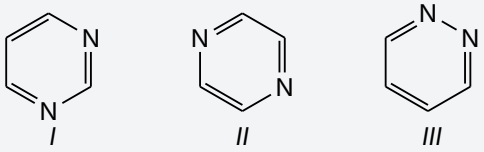
In the following molecules, which one is more basic and why?



A *B*

IFoS 2022 · Q3(d) Aromatic character of diazines [5 marks]

Arrange the following molecules in the decreasing order of their aromatic character:

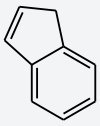


I *II* *III*

2021

CSE 2021 · Q3(b) Cyclopropenyl cation; acidity of indene and cyclopentadiene; tropolones and sydnones [15 marks]

(i) Write the structure of the reaction product between 3-chlorocyclopropene and $SbCl_5$. What is the unique feature of this product in ^1H NMR spectrum?

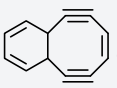
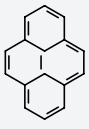
(ii) A  B 

Which one of the above compounds is more acidic and why?

(iii) Predict the aromaticity of tropolones and sydnones.

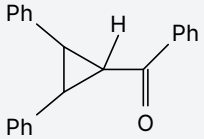
IFoS 2021 · Q1(a) Aromaticity classifications [5 marks]

Assign the following compounds as aromatic, antiaromatic and non-aromatic:

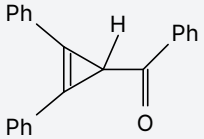
Cyclooctatetraene; cyclobutadiene;  ; 

IFoS 2021 · Q3(a)(i) Hydrogen exchange in cyclopropyl ketones [5 marks]

(i) Hydrogen exchange reaction of the compound A is 6×10^3 times faster than the compound B (given below). Justify your answer. 5



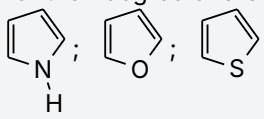
(A)



(B)

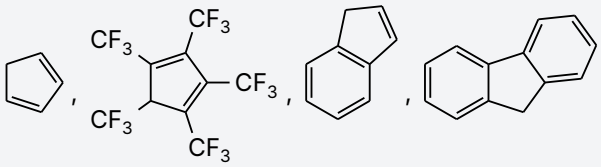
IFoS 2021 · Q3(c)(ii) Aromaticity of five-membered heterocycles [5 marks]

(ii) Arrange the following in increasing order of their degree of aromaticity and justify your answer. 5



IFoS 2021 · Q5(g) Acidity of cyclopentadiene derivatives [5 marks]

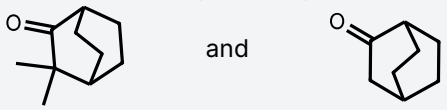
Arrange the following compounds in increasing order of their acidity:



2020

IFoS 2020 · Q1(b) Enolisation of two bicyclic ketones (Bredt's rule) [5 marks]

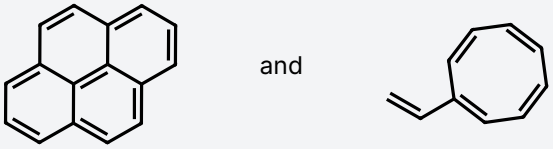
Which of the following gets enolised more extensively and why?



I II

IFoS 2020 · Q2(a) Aromatic, non-aromatic or anti-aromatic: pyrene and vinylcyclooctatetraene [5 marks]

Comment on the following structures as aromatic/non-aromatic/anti-aromatic and justify your answer.



I II

2019

CSE 2019 · Q1(a) Is [14]annulene aromatic? [10 marks]

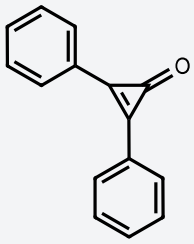
Is [14] annulene aromatic according to Hückel rule? Justify your answer.

CSE 2019 · Q4(a) Sydnone and imidazole; imidazolium and imidazolide ions [15 marks]

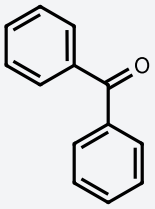
How is sydnone different from imidazole? Imidazole upon reaction with an acid gives two products. Comment on the aromaticity of the products.

IFoS 2019 · Q1(c) Dipole moments of diphenylcyclopropenone and benzophenone [5 marks]

Which of the following compounds has the greater dipole moment? Justify your answer:



A



B

2018

CSE 2018 · Q1(a) π-MO energy levels: benzene, cyclobutadiene, cyclopentadienyl anion [10 marks]

Draw the π-molecular orbital energy level diagram for the following :
(i) Benzene (ii) Cyclobutadiene (iii) Cyclopentadienyl anion

CSE 2018 · Q7(a) Aromatic, anti-aromatic or non-aromatic [10 marks]

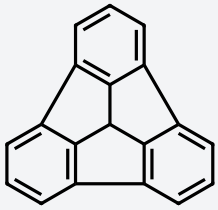
Classify the following examples as aromatic, anti-aromatic or non-aromatic. Write their structures also :
(i) Tetrahydrofuran (ii) Cyclooctatrienyl dianion (iii) Azulene (iv) Tropolone

IFoS 2018 · Q1(a) Dipole moments of naphthalene (0 D) and azulene (1.08 D) [5 marks]

Explain why the dipole moment of naphthalene is 0·00 D and that of azulene is 1·08 D.

IFoS 2018 · Q1(b) Acidity of a fused fluorenyl hydrocarbon versus Ph_3CH [5 marks]

Which one of the following compounds is more acidic? Justify your answer:

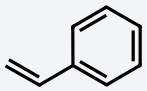


and Ph_3CH

2017

CSE 2017 · Q1(a) Aromatic, anti-aromatic or non-aromatic [10 marks]

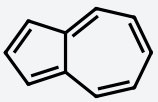
Classify the following examples into aromatic, anti-aromatic and non-aromatic. Justify your answer.



(i)



(ii)



(iii)



(iv)



(v)

CSE 2017 · Q2(b) Acidity of dimethyl-4-nitrophenols: steric inhibition of resonance [10 marks]

Out of 3,5-dimethyl-4-nitrophenol and 2,6-dimethyl-4-nitrophenol, which one is more acidic and why?

IFoS 2017 · Q1(a) An aromatic sandwich compound [5 marks]

Name a sandwich compound which is aromatic in character. Draw its structure.

IFoS 2017 · Q1(b) Sydnones [5 marks]

What are sydnones? Draw a representative structure.

IFoS 2017 · Q3(b) Cyclopropenyl cation, anion and radical: which is aromatic? [10 marks]

Which of the following is(are) aromatic?
(i) Cyclopropenyl cation
(ii) Cyclopropenyl anion
(iii) Cyclopropenyl free radical
Justify your answer.

IFoS 2017 · Q3(c) Dipole moment and aromaticity of azulene [10 marks]

Account for the observed dipole moment and aromaticity in azulene.

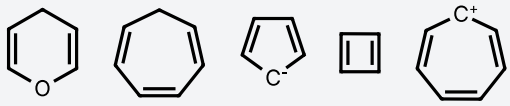
2016

CSE 2016 · Q1(a) Azulene: resonance structures and dipole moment [10 marks]

Write the resonating structures of azulene and explain why it exhibits dipole moment (∼1.0 D).

CSE 2016 · Q4(b) Aromatic, non-aromatic or anti-aromatic [10 marks]

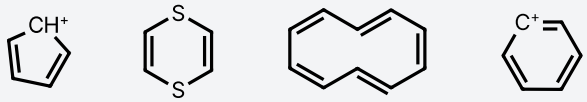
Classify the following as aromatic, non-aromatic and anti-aromatic. Give reasons:



(i) *(ii)* *(iii)* *(iv)* *(v)*

IFoS 2016 · Q1(a) Aromatic, antiaromatic or non-aromatic [5 marks]

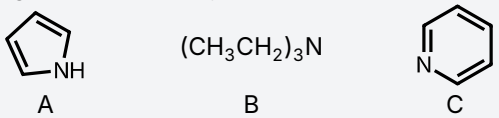
Classify the following compounds as aromatic, antiaromatic and non-aromatic. Explain your answer.



A B C D

IFoS 2016 · Q1(e) Basicity of pyrrole, triethylamine and pyridine [5 marks]

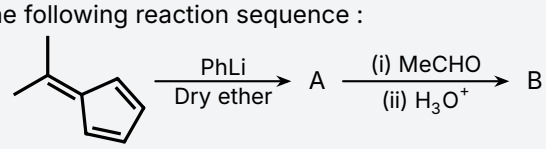
Arrange the following in decreasing order of basicity. Give explanation to justify your answer.



A B C

IFoS 2016 · Q1(g) 6,6-Dimethylfulvene, phenyllithium and acetaldehyde [5 marks]

Write the products formed in the following reaction sequence :



IFoS 2016 · Q2(d) Aromatic character of sydnones [10 marks]

Write a short note on aromatic character of sydnones.