29. An introduction to A Level organic chemistry

29.3 Shapes of aromatic organic molecules; σ and π bonds

Paper 4

Marking Scheme

Q1.

(b)	<table><tr><th></th><th>sp</th><th>sp^2</th><th>sp^3</th></tr><tr><td>Kekulé benzene</td><td>0</td><td>6</td><td>0</td></tr><tr><td>Dewar benzene</td><td>0</td><td>4</td><td>2</td></tr><tr><td>Ladenburg benzene</td><td>0</td><td>0</td><td>6</td></tr></table> **M1** row 1 and 2 correct **M2** row 3 correct	**2**
(c)	**M1** 120° **AND** hexagonal/trigonal planar **M2** C-C has π-bonds and σ-bonds **AND** C-H have σ-bonds only	**2**
(d)	bond strain **OR** ring strain	**1**

Q2.

(c)	0, 5, 1 [1]	**1**

Q3.

(a)	**M1** bond angle = 120° **AND** carbons are sp^2 **M2** σ bonds are formed by end-on-end / head on / head to head / linear overlap of orbitals **M3** π bonds are formed by sideways / lateral overlap of p orbitals	**3**

Q4.

(d)	**M1** N sp^2 **AND** C sp^2 **M2** σ bonds are formed by end-on-end overlap orbitals between C-H / C-C / C-N **M3** π bonds are formed by sideways overlap of p orbitals between C-N / C-C	**3**

Q5.

(a)	120° **AND** sp^2	**1**

Q6.

(a)(i)	• trigonal planar • tetrahedral. • trigonal planar Award one mark for two correct statements, award two marks for three correct statements	**2**

Q7.

(a)	Any four from the following points: • (regular) hexagon **OR** planar • all C–C bonds same length [1] • all bond angles 120° • all carbon atoms sp^2 hybridised [1] • C–H bonds are s–sp^2 overlap [1] • C–C bonds have sp^2–sp^2 overlap [1] • C–C bonds have p–p overlap • π used correctly and σ used correctly once each	**4**

Q8.

(a)	any **three** points from: 3 × [1] • bond angle = 120° **and** shape is (hexagonal ring) planar / (trigonal) planar • carbons are sp^2 hybridised • contains <u>delocalised electrons</u> in the **π** bonds / system • sp^2 orbitals between C-H / C-C overlap to form **σ bonds** • a **p orbital** from each carbon atom overlap sideways with each other above and below the ring forming **π bonds** **ALLOW** labelled diagrams for bullets 1–5	**3**

Q9.

(a)(i)	10	**1**
(a)(ii)	120	**1**