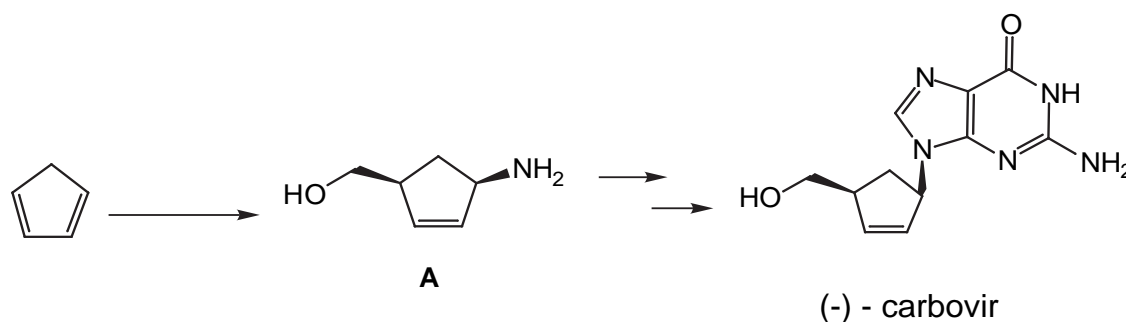


12. Answer *all* parts **A**, **B** and **C** of this question. Note that this question is on *three* pages.

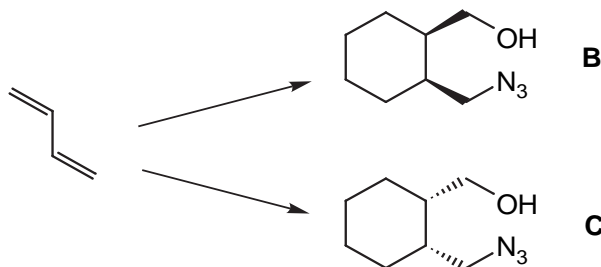
Part A

In this question you are asked to devise chemoenzymatic syntheses of compounds **A-C** from achiral starting materials. In both parts you should indicate the source of chirality.

(a) **A** is a key intermediate in the synthesis of the antiviral reagent (-)-carbovir. Devise a chemoenzymatic synthesis of enantiopure **A** from cyclopentadiene or another starting material of your choice (more than one step may be required). *NB* : You are *not* required to comment on the synthesis of carbovir from **A**. [6]



(b) Devise a chemoenzymatic synthesis of *both* enantiomers **B** and **C** from 1,3-butadiene or a starting material of your choice. [6]

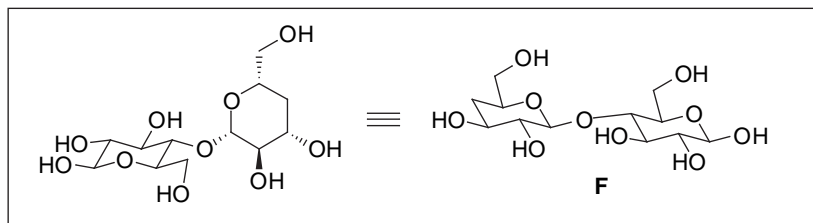
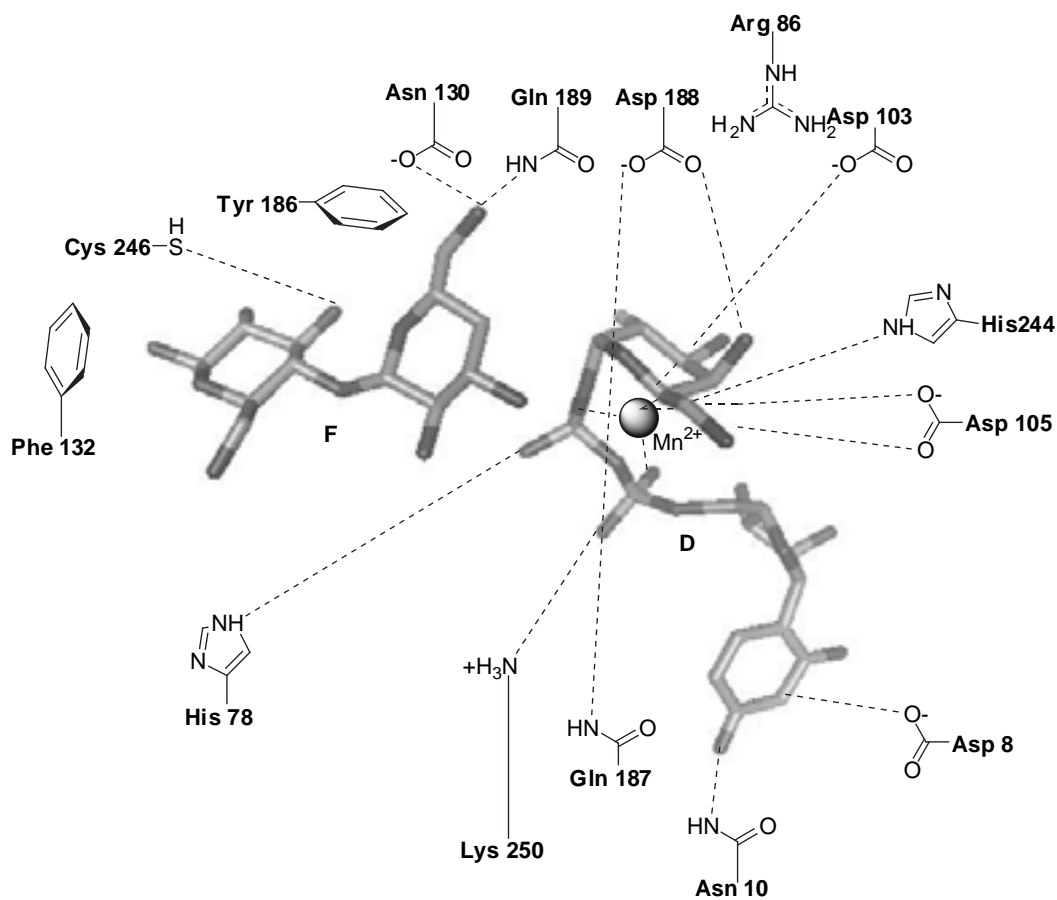
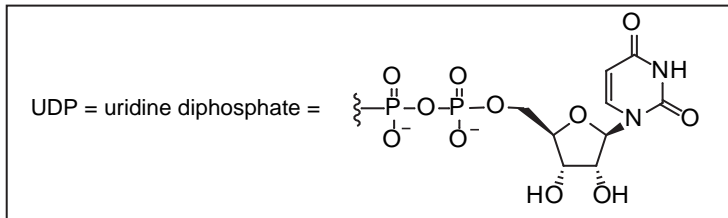
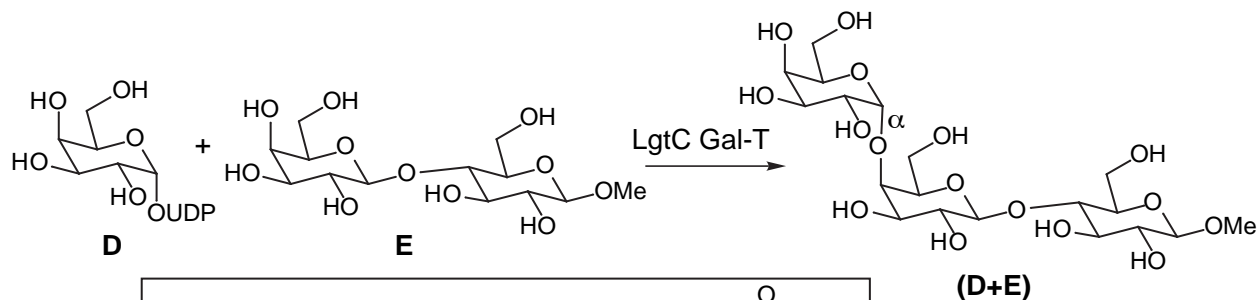


Part B

The galactosyltransferase enzyme from the LgtC gene of *Neisseria meningitidis*, LgtC Gal-T, has just been isolated and its X-ray crystal structure determined using **D** and the *substrate analogue* **F** bound to the active site. By examining the reaction that it catalyzes (**D** + **E**) and the representation of the 3D structure given opposite:

(a) Suggest a mechanism of action of LgtC Gal-T showing clearly the key active site residues that may be involved. [5]

(b) Indicate how could you test your hypothesis. [2]



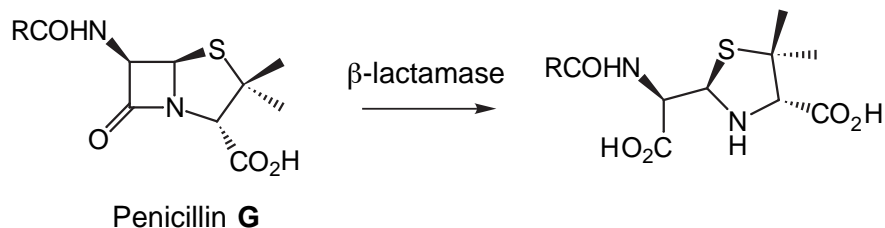
Notes:

1. ----- indicates potential interaction within hydrogen bonding distance in the X-ray crystal structure
2. Protonation states of amino acid side chains have been assigned arbitrarily
3. Protein residues are represented schematically and do not necessarily represent their true positions in space but instead give an indication of their relative proximity to groups in the substrates

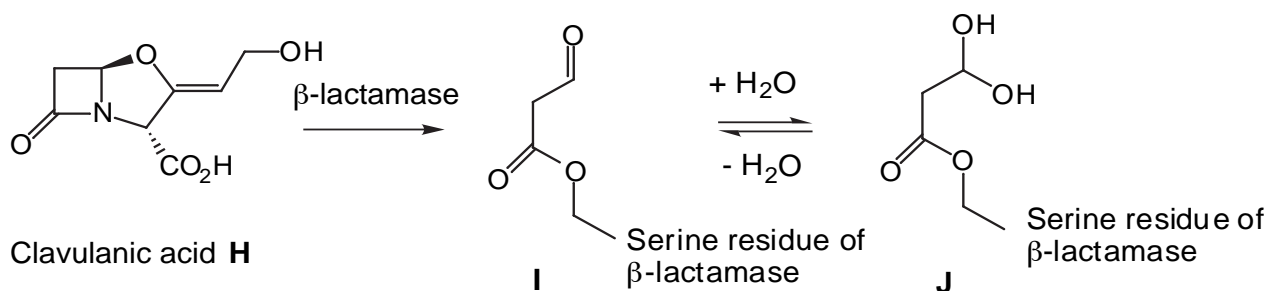
**QUESTION CONTINUES
TURN OVER**

Part C

(a) Outline a mechanism for the serine β -lactamase enzyme catalysed hydrolysis of penicillin **G**. [2]



(b) Give a plausible mechanism for the production of **I** and **J**, which are formed during β -lactamase inhibition by clavulanic acid **H**. [8]



(c) Suggest how Sulbactam **K** inhibits β -lactamases. [5]

