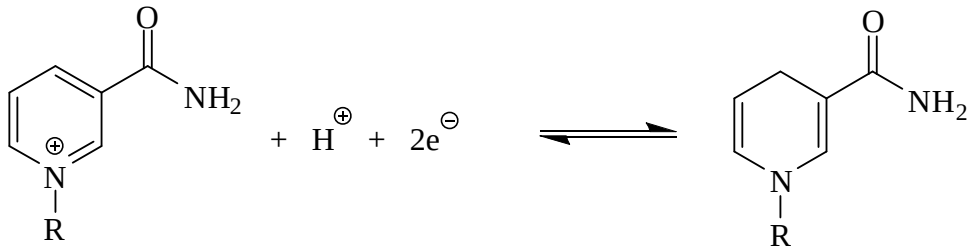
- What are the requirements for a molecule to be aromatic? Give one example of an aromatic heterocycle.

2

Marks 4

- NAD^+ and NADH are coenzymes used by animals in oxidation and reduction reactions. They are related by the following half-reactions.



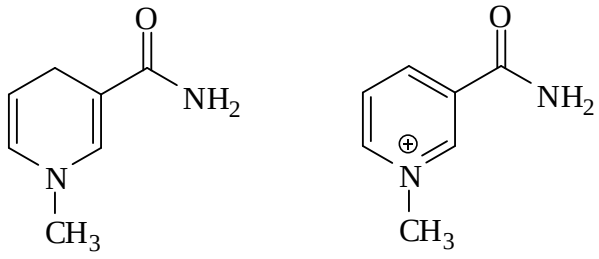
Which of these coenzymes is used in the biological oxidation of ethanol, CH_3CH_2OH?

What is the product of the biological oxidation of ethanol, CH_3CH_2OH?

Which of NAD^+ and NADH is aromatic? Give reasons for your answer.

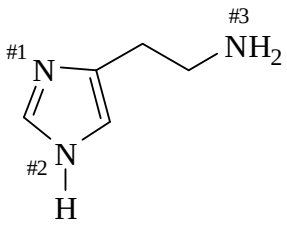
2

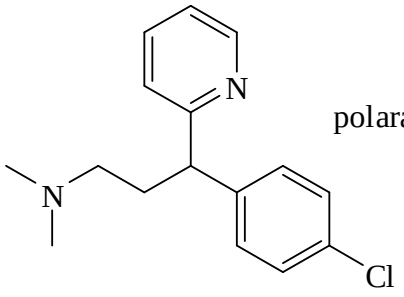
Using a spectroscopic technique, how would you distinguish between the following pairs of compounds? Indicate the observations you would make.

Compounds	Technique and observation
	
	

Marks 6

- The structures of histamine and polaramine are shown below.

histamine 



polaramine

Indicate the hybridisation and geometry of bonds around each of the nitrogen atoms in histamine.

	Hybridisation	Geometry of bonds
N #1:		
N #2:		
N #3:		

Draw a tautomer of histamine.

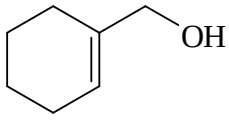
In histamine, only one of the nitrogen atoms in the ring is easily protonated (basic). Indicate which it is and explain why.

THIS QUESTION CONTINUES ON THE NEXT PAGE.

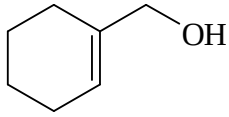
	Marks
The release of histamine in the body triggers nasal secretions and constriction of airways. Polaramine is one of many anti-histamine compounds used to treat allergies. Explain what structural features of polaramine might make it a suitable anti-histamine agent.	**3**
(+)-2-[*p*-Chloro-α-[2-(dimethylamino)ethyl]benzyl]pyridine is another name for polaramine. What does the (+) in this name mean?	

- Indicate the major organic product(s) in the following reactions.

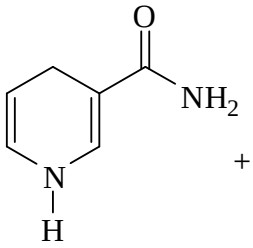
Marks 4



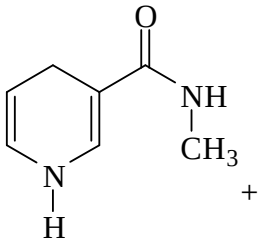
+ CH_3COCl ⟶



+ $Cr_2O_7^{2\ominus}$ / $H^{\oplus}$ ⟶



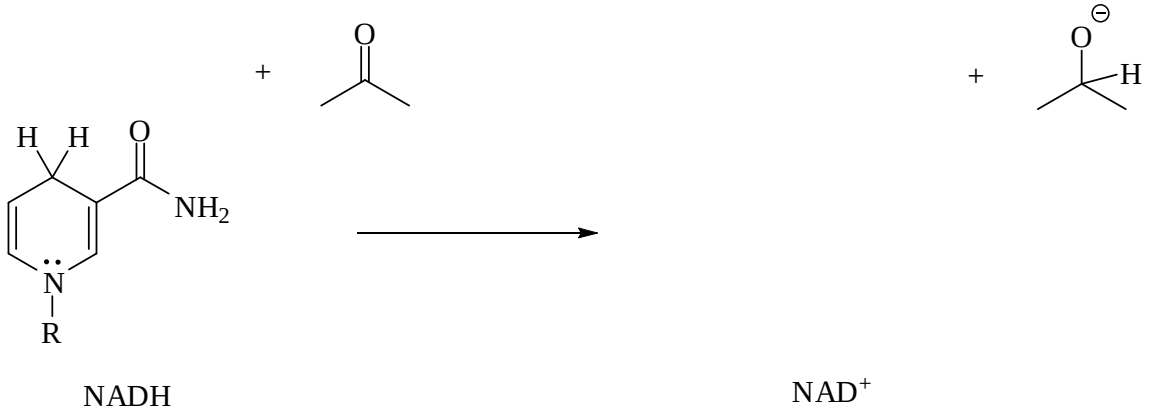
+ cold dilute $H^{\oplus}$ / H_2O ⟶



+ hot conc. $H^{\oplus}$ / H_2O ⟶

- NADH is the most important reducing agent in Nature. It is itself oxidised to NAD^+. Complete the scheme below by:
  (a) drawing in curly arrows to show the movement of electrons during the first step in the reduction of acetone with NADH, and
  (b) drawing the structure of NAD^+.

3



NADH NAD^+

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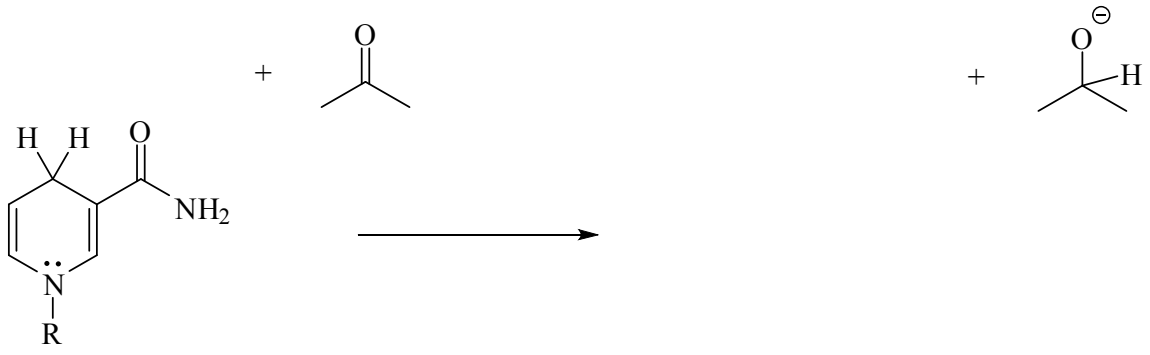

NADH NAD^+

- Rank the following compounds in order of base strength and explain your reasoning. You may use diagrams to assist your explanation.

3