

1. **Nov/2023/Paper\_9701/11/No.24**

If ammonium cyanate is heated in the absence of air, the only product of the reaction is urea,  $\text{CO}(\text{NH}_2)_2$ . No other products are formed in the reaction.

What is the formula of the cyanate ion present in ammonium cyanate?

- A  $\text{CON}_2^-$       B  $\text{CON}_2^{2-}$       C  $\text{OCN}^-$       D  $\text{OCN}^{2-}$

2. **Nov/2023/Paper\_9701/12/No.26**

$\text{NaOH}(\text{aq})$  is added to  $\text{NH}_4\text{Cl}(\text{aq})$ . The mixture is warmed.

The gas that is produced turns damp red litmus paper blue.

Which row is correct?

	behaviour of the ammonium ion in $\text{NH}_4\text{Cl}$	behaviour of the water present on the litmus paper
<b>A</b>	Brønsted–Lowry acid	Brønsted–Lowry base
<b>B</b>	Brønsted–Lowry acid	Brønsted–Lowry acid
<b>C</b>	Brønsted–Lowry base	Brønsted–Lowry acid
<b>D</b>	Brønsted–Lowry base	Brønsted–Lowry base

3. Nov/2023/Paper\_9701/22/No.2(d, e)

(d) Identify one natural process and one man-made process that cause the formation of atmospheric NO and NO<sub>2</sub>.

natural process .....

man-made process .....

[2]

(e) NO<sub>2</sub> is a brown gas that can be used to form nitric acid.

(i) NO<sub>2</sub> is a free radical.

Define free radical.

..... [1]

(ii) NO<sub>2</sub> has a catalytic role in the oxidation of atmospheric sulfur dioxide.

Write equations to show the catalytic role of NO<sub>2</sub> in this oxidation.

.....  
..... [2]

(iii) State **one** environmental consequence of the oxidation of atmospheric sulfur dioxide.

..... [1]

4. June/2023/Paper\_9701/11/No.20

Which emission from an internal combustion engine contributes to the erosion of marble statues?

A carbon monoxide

B nitrogen

C nitrogen dioxide

D unburnt hydrocarbons

5. June/2023/Paper\_9701/12/No.23

Ammonium sulfate,  $(\text{NH}_4)_2\text{SO}_4$ , and ammonium nitrate,  $\text{NH}_4\text{NO}_3$ , are used as fertilisers.

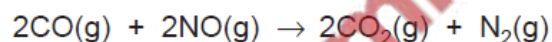
These salts have different percentages by mass of nitrogen. They have the same effect as each other on the pH of wet neutral soil.

Which row is correct?

	higher percentage of nitrogen by mass	effect on pH of soil
A	ammonium nitrate	decrease
B	ammonium nitrate	increase
C	ammonium sulfate	decrease
D	ammonium sulfate	increase

6. June/2023/Paper\_9701/12/No.24

The equation shows a reaction that occurs between carbon monoxide and nitrogen monoxide in a catalytic converter.



Which statement is correct?

- A The catalyst used is finely divided iron.
- B The reaction prevents greenhouse gas emissions into the atmosphere.
- C The reaction reduces the possibility of the formation of photochemical smog.
- D The reaction results in increased ozone depletion.

7. June/2023/Paper\_9701/13/No.20

HCN has been detected in interstellar gas. The molecules below have also been detected in interstellar gas.

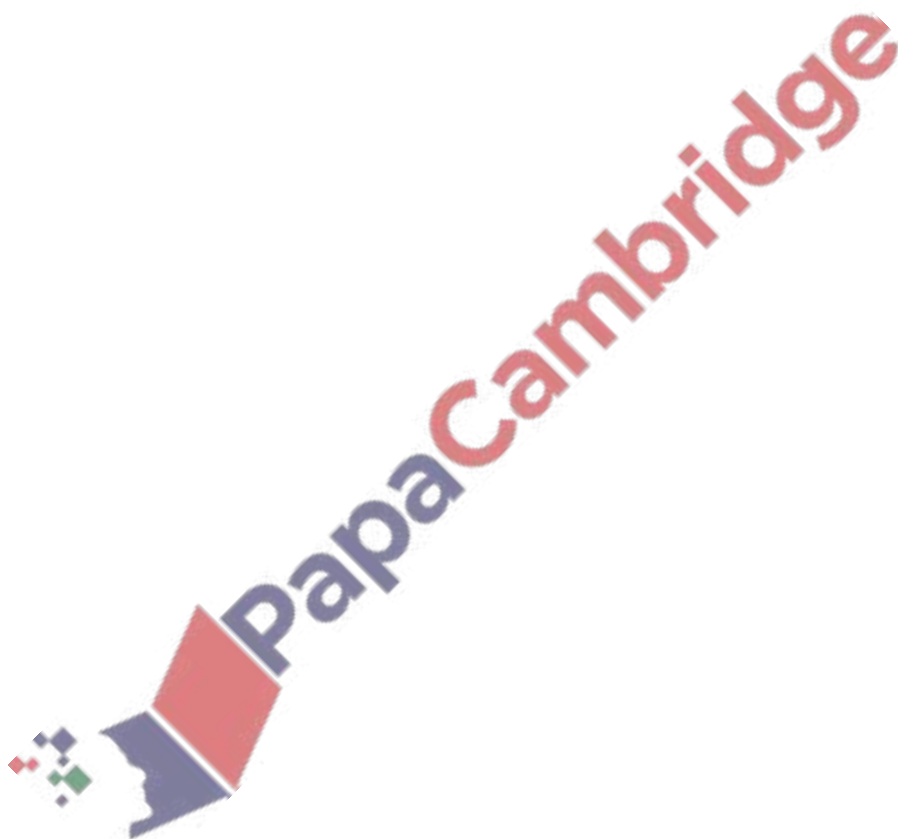
Which molecule contains the same total number of valence shell (outer shell) electrons as HCN?

- A HNO                      B  $\text{NH}_3$                       C NO                      D PN

8. June/2023/Paper\_9701/13/No.26

Which statement about the oxides of nitrogen is correct?

- A During lightning storms, atmospheric oxygen and nitrogen combine to form oxides of nitrogen.
- B In a catalytic converter, nitrogen monoxide is removed by reaction with carbon dioxide.
- C In car engines, the restricted supply of oxygen eliminates the possibility of the formation of oxides of nitrogen.
- D In the atmosphere, nitrogen monoxide reacts with sulfur dioxide to produce sulfur trioxide.



(a) Molecule **M** is present in petrol, a fuel used in cars. **M** is a saturated, non-cyclic hydrocarbon. **M** contains eight carbon atoms.

(i) Construct an equation for the complete combustion of **M**.

..... [2]

(ii) Describe how the composition of products differs when incomplete combustion of **M** occurs.

.....  
..... [2]

(b) When petrol is burned in an internal combustion engine, oxides of nitrogen are released into the atmosphere. Oxides of nitrogen are responsible for the formation of acid rain.

(i) Suggest the conditions required for the production of oxides of nitrogen during combustion of **M** in an internal combustion engine. Use an appropriate equation in your answer.

.....  
.....  
.....  
..... [2]

(ii) Describe how acid rain is formed in the atmosphere in the presence of oxides of nitrogen and  $\text{SO}_2$ . Identify the role of the oxides of nitrogen in this process. Include **all** relevant equations.

.....  
.....  
..... [3]

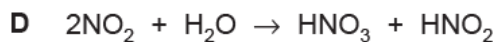
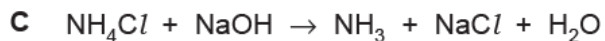
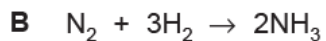
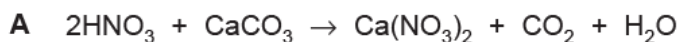
(iii) State **one** other type of air pollution that is caused by the production of oxides of nitrogen in an internal combustion engine.

..... [1]

10. March/2023/Paper\_9701/12/No.1

Four equations representing reactions of nitrogen or one of its compounds are given.

Which equation represents a disproportionation reaction?



11. March/2023/Paper\_9701/12/No.17

Two procedures are described.

- 1 Sulfur is burned in an excess of oxygen and then NO is added to the product mixture.
- 2 Sulfur is burned in an excess of oxygen and then NO<sub>2</sub> is added to the product mixture.

Which procedures will produce some sulfur trioxide, SO<sub>3</sub>?

- A both 1 and 2    B 1 only    C 2 only    D neither 1 nor 2

Alkenes undergo an addition reaction with a 1:1 mixture of CO and H<sub>2</sub> to form aldehydes.

Fig. 3.1 shows the reaction of propene with a 1:1 mixture of CO and H<sub>2</sub>.

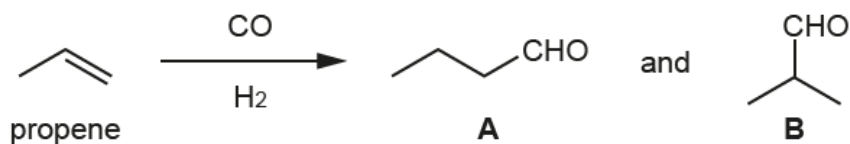


Fig. 3.1

(a) (i) Define addition reaction.

.....  
..... [1]

(ii) Aldehydes **A** and **B** are structural isomers.

State the type of structural isomerism shown by **A** and **B**.

..... [1]

(iii) Name **A**.

..... [1]

(iv) The complete reaction of propene with a 1:1 mixture of CO and H<sub>2</sub> produces **A** and **B** only. The product mixture contains 96% **A** and 4% **B**.

Calculate the mass of **A** produced in this reaction when  $5.00 \times 10^3$  kg of propene is used.

mass of **A** = ..... kg [1]