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ST ANDREW'S JUNIOR COLLEGE



JC2 PRELIMINARY EXAMINATION

Chemistry (9729)

17 September 2018

Paper 1 Multiple Choice

1 hour

Additional Materials: Multiple Choice Answer Sheet, Data Booklet

READ THESE INSTRUCTIONS:

Write in soft pencil.

Do not use staples, paper clips, glue or correction fluid.

There are **thirty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A, B, C** and **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer sheet.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

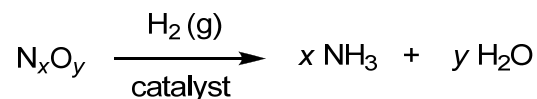
Any rough working should be done in this booklet.

The use of an approved scientific calculator is expected, where appropriate.

This document consists of **14** printed pages.

[Please Turn Over

- 1 To identify an oxide of nitrogen, the oxide is mixed with an excess of hydrogen and passed over a catalyst at a suitable temperature.



The water collected weighs 0.133 g. The ammonia produced is neutralised by 18.50 cm³ of 0.2 mol dm⁻³ HCl.

Which of the following could be the oxide?

- 1 N₂O
 - 2 NO₂
 - 3 NO₃
 - 4 N₂O₄
- A 3 only
 B 1 and 2 only
 C 2 and 3 only
 D 2 and 4 only
- 2 This question is about sparingly soluble salts.

	AgCl	AgI	HgI₂
<i>K_{sp}</i>	1.0×10^{-10}	8.3×10^{-16}	1.1×10^{-21}

From the above information, which statements are **not** true?

- A For a solution containing 1 mol dm⁻³ of NaCl and NaI, the concentration of chloride ions when AgI just starts to precipitate is 1 mol dm⁻³.
- B The solubility of HgI₂ is 6.50×10^{-8} mol dm⁻³.
- C The solubility of HgI₂ is the lowest.
- D The units for *K_{sp}* for HgI₂ is mol³ dm⁻⁹.

- 3 The following tests were performed on an aqueous solution containing bromide and iodide ions.

Step	Test	Observations
1	Add excess $\text{AgNO}_3(\text{aq})$.	A mixture of cream and yellow precipitate were formed.
2	To the mixture from step 1, add concentrated NH_3 .	The cream precipitate dissolved to form a colourless solution. The yellow precipitate was insoluble.
3	Filter the mixture from step 2.	Filtrate was a colourless solution. Residue was a yellow solid.
4	Add $\text{Cl}_2(\text{aq})$ to filtrate.	Brown solution is formed.

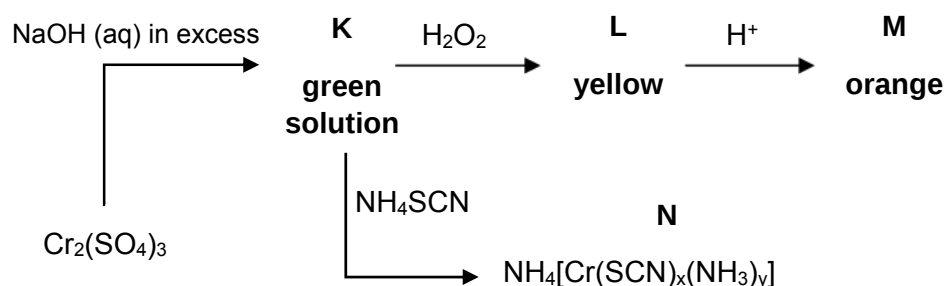
Which of the following statements is correct?

- A** In step 2, the cream precipitate dissolved because the addition of concentrated NH_3 results in formation of a complex which decreases the K_{sp} of AgBr .
- B** In step 2, the yellow precipitate was insoluble because the K_{sp} of AgI is higher than the K_{sp} of AgBr .
- C** In step 2, the yellow precipitate was insoluble because the ionic product of AgI is higher than the K_{sp} of AgI .
- D** In step 4, a disproportionation reaction has taken place.
- 4 A stable ion of **Q** has the following properties:
- has a noble gas configuration
 - has more protons than electrons
 - was obtained by removing electrons from the same orbital

Which of the following could be **Q**?

- A** Al **B** Ca **C** Cu **D** S

- 5 Chromium and its compounds undergo the following reactions.



N has the following composition by mass: Cr, 15.5%; S, 38.1%; N, 29.2%.

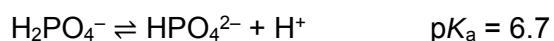
Which of the following can be deduced from the above reaction scheme?

- A** The values of x and y in **N** are 4 and 2 respectively.
 - B** The types of reactions that occur are ligand exchange and redox only.
 - C** The formula of **K** is $\text{Cr}(\text{OH})_2(\text{H}_2\text{O})_6$.
 - D** H_2O_2 is a reducing agent in the conversion of **K** to **L**.
- 6 Which one of the following statements about Group 2 elements and their compounds is correct?
- A** Beryllium chloride has a higher boiling point than magnesium chloride as it has a more exothermic lattice energy than magnesium chloride.
 - B** The reducing power of Group 2 elements increases down the group.
 - C** 1 mole of barium carbonate, on heating over a short period of time, decomposes to give more carbon dioxide gas than 1 mole of magnesium carbonate.
 - D** Barium has a higher melting point than magnesium due to more electrons.
- 7 Liquefaction can be defined as a process that generates a liquid from a gas and this can be done by altering pressure. In the liquefaction of CH_4 and NH_3 , the pressure needed for NH_3 is less than CH_4 .

Which of the following reasons best explains this observation?

- A** NH_3 has stronger intermolecular forces of attraction than CH_4 .
- B** NH_3 has weaker bond energy than CH_4 .
- C** NH_3 molecules are bigger than CH_4 molecules.
- D** NH_3 molecules possess less kinetic energy than CH_4 molecules.

- 8 Phosphate buffers are commonly used in biological chemistry research.

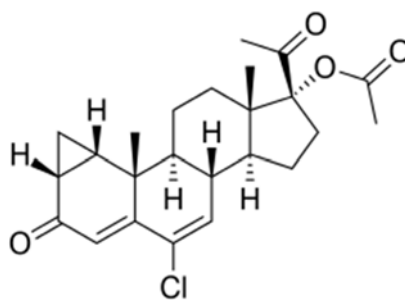


A phosphate buffer with pH 7.4 was prepared using NaH_2PO_4 and Na_2HPO_4 solutions. The total hydrogen phosphates concentration ($[\text{HPO}_4^{2-}] + [\text{H}_2\text{PO}_4^-]$) of the buffer was 0.3 mol dm^{-3} .

What are the concentrations of NaH_2PO_4 and Na_2HPO_4 used to create this buffer?

	$[\text{NaH}_2\text{PO}_4] / \text{mol dm}^{-3}$	$[\text{Na}_2\text{HPO}_4] / \text{mol dm}^{-3}$
A	0.23	0.07
B	0.07	0.23
C	0.10	0.50
D	0.05	0.25

- 9 Cyproterone acetate (CPA) is a drug that is used in the treatment of prostate cancer.



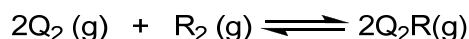
CPA

Which of the following statements about CPA are incorrect?

- 1 One mole of silver is formed when one mole of CPA is warmed with $[\text{Ag}(\text{NH}_3)_2]^+$.
- 2 Two moles of yellow precipitate is formed when one mole of CPA is warmed with alkaline iodine solution.
- 3 One mole of silver chloride is formed when one mole of CPA is heated with ethanolic silver nitrate.

- A** 1 only **B** 1 and 2 only **C** 2 and 3 only **D** 1, 2 and 3

- 10 Consider the following equilibrium:



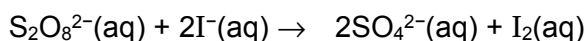
When Q_2 is allowed to react with R_2 in a molar ratio of 2:1 at a total initial pressure of 3 atm, 20% of the equilibrium mixture is found to be Q_2R .

What is the equilibrium constant, K_p , of this reaction?

- A 0.0174 atm⁻¹
- B 0.0781 atm⁻¹
- C 0.194 atm⁻¹
- D 0.232 atm⁻¹

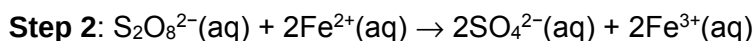
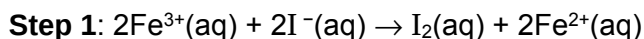
- 11 *Use of the Data Booklet is relevant to this question.*

Iodine clock reaction can be used to study how the concentration of iodide ions affect the rate of oxidation of iodide ions with peroxodisulfate ions. Peroxodisulfate ions convert iodide ions into iodine slowly.



The rate of the reaction can be increased by the addition of catalysts such as aqueous iron (III) ions.

A possible catalysed reaction pathway involves the following steps:

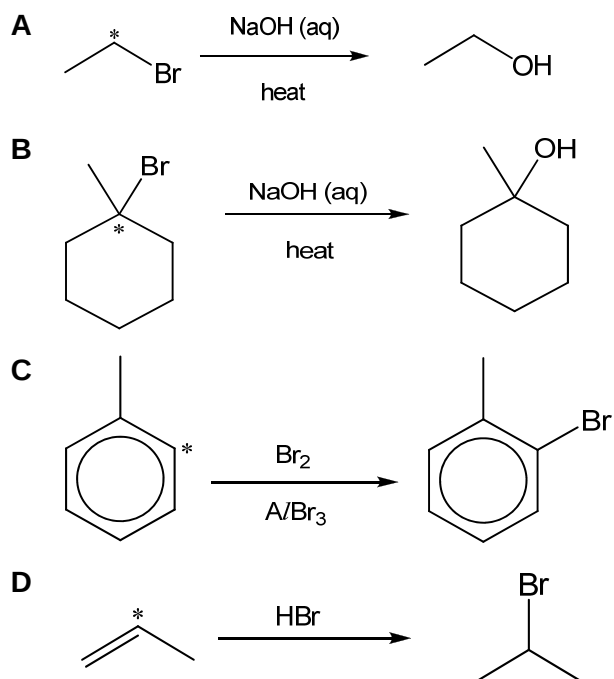


Which of the following statements are **correct**?

- 1 Aqueous cobalt(II) ions can be used as a catalyst in this reaction.
- 2 $\text{S}_2\text{O}_8^{2-}$ is a stronger oxidising agent than Fe^{3+} .
- 3 The $E_{\text{cell}}^\ominus$ for step 2 is more positive than step 1.

- A 2 only
- B 1 and 3 only
- C 2 and 3 only
- D 1, 2 and 3

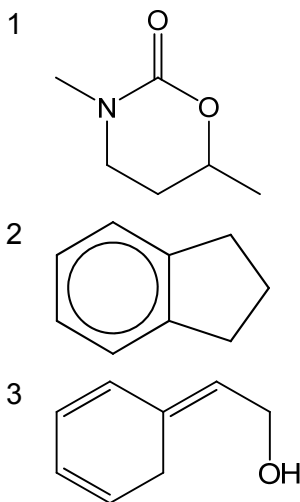
- 12** Which of the following reactions has no change in the hybridisation state of the carbon atom indicated with an asterisk (*) from the reactant to the **intermediate** in the mechanism?



- 13** What is the volume of vapour formed when 10 cm³ of liquid ethanol (density: 0.789 g cm⁻³) is heated to 300 °C at a pressure of 5 bar?

- A** 85.5 cm³
B 855 cm³
C 163.3 cm³
D 1633 cm³

- 14 Which compounds liberate carbon dioxide gas when heated with acidified potassium manganate(VII)?



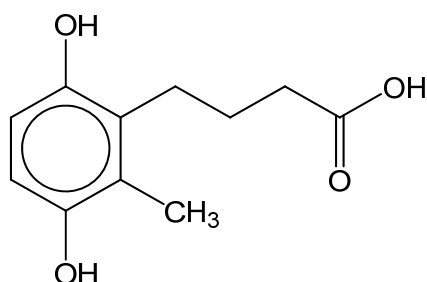
- A 1 and 2 only
 B 2 and 3 only
 C 1, 2 and 3
 D None of the above
- 15 Trifluorooxonium has the formula OF_3^{n+} and its shape is trigonal pyramidal. What is the value of n in trifluorooxonium?
- A 1 B 2 C 3 D 4
- 16 Use of the Data Booklet is relevant to this question.
 Which set of reagents, when added in the order shown below, would convert $\text{Fe}^{3+}(\text{aq})$ to $[\text{Fe}(\text{CN})_6]^{3-}(\text{aq})$?



	step 1	step 2	step 3
A	Zn(s)	$\text{CN}^{-}(\text{aq})$	$\text{SO}_2(\text{g})$
B	$\text{I}^{-}(\text{aq})$	$\text{CN}^{-}(\text{aq})$	$\text{Cl}_2(\text{g})$
C	$\text{H}_2\text{O}_2(\text{aq})$	$\text{I}^{-}(\text{aq})$	$\text{CN}^{-}(\text{aq})$
D	Ag(s)	$\text{I}^{-}(\text{aq})$	$\text{CN}^{-}(\text{aq})$

- 17** Compound **X** is dissolved in heavy water, D_2O . It contains a number of hydrogen atoms which can be easily be replaced by deuterium, D.

[D, deuterium = 2H]



Compound **X**

What is the maximum number of hydrogen atoms which could be replaced by deuterium atoms in each molecule of **X**?

- A** 1 **B** 2 **C** 3 **D** 4

- 18** Which of the following, when mixed together at 298K and 1 bar, represent the standard enthalpy change of neutralisation?

- 1 500 cm³ of 1 mol dm⁻³ HNO₃ and 500 cm³ of 1 mol dm⁻³ KOH
- 2 500 cm³ of 1 mol dm⁻³ H₂SO₄ and 500 cm³ of 1 mol dm⁻³ Ca(OH)₂
- 3 1 dm³ of 1 mol dm⁻³ HNO₃ and 500 cm³ of 1 mol dm⁻³ Ca(OH)₂
- 4 1 dm³ of 1 mol dm⁻³ H₂SO₄ and 1 dm³ of 1 mol dm⁻³ KOH

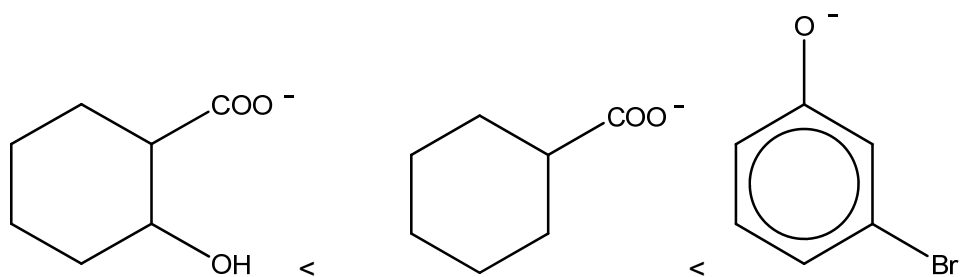
- A** 1 only **B** 2 and 3 only **C** 2, 3 and 4 only **D** 1, 2, 3 and 4

- 19** Which of the following cannot act as a ligand?

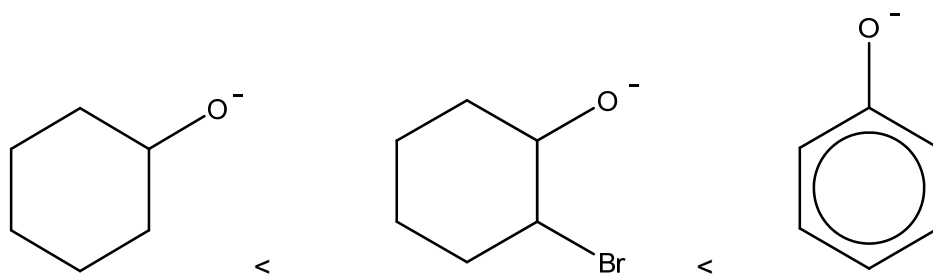
- A** AlH_4^-
B N_2H_4
C CH_3OH
D CO

20 Which of the following shows an increasing trend in K_b ?

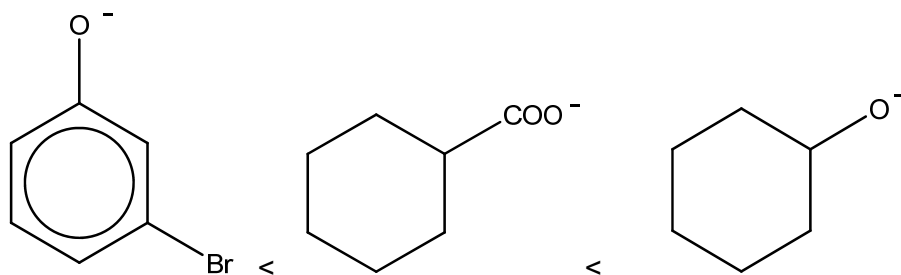
A



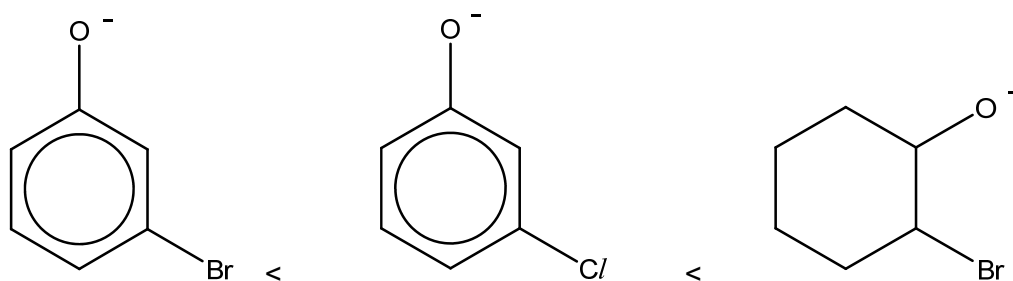
B



C



D



21 Which quantity would best indicate the strength of intermolecular hydrogen bonds in HF?

A enthalpy change of vapourisation

B enthalpy change of formation

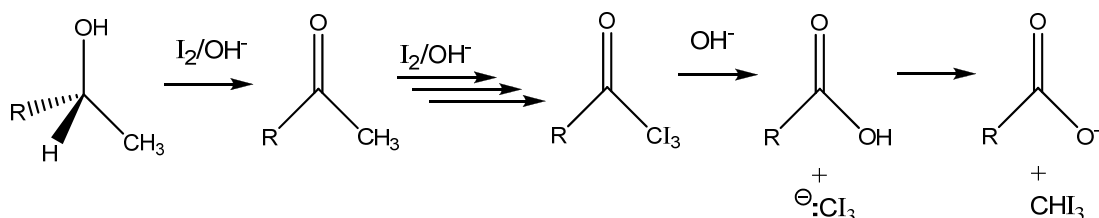
C enthalpy change of atomisation

D bond dissociation energy

- 22 The following data refer to cobalt as a typical transition element and calcium as an s-block element. Which of the following properties shows the correct data for both elements?

	Property	Cobalt	Calcium
A	Metallic radius / nm	0.150	0.117
B	Electrical conductivity / relative units	10.2	50
C	Melting point / °C	1495	1965
D	Density / g cm ⁻³	8.9	1.54

- 23 The reaction of methyl alcohols with alkaline aqueous iodine can be described by the simplified scheme as shown below:



Which of the following reactions have taken place?

- 1 Oxidation
- 2 Acid-base reaction
- 3 Nucleophilic addition

- A 1 only B 1 and 2 only C 1 and 3 only D 1, 2 and 3

- 24 Nitrogen, ¹⁴N, is the final product formed by the radioactive decay of ¹⁴C, which is a first-order reaction with a half-life of 5.73 × 10³ years.

What would be the age of a substance, originally nitrogen free, in which the molar proportion of ¹⁴C : ¹⁴N is 2 : 5?

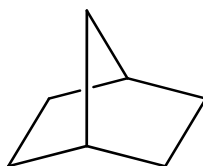
- A 0.29 × 10⁴ years
 B 1.04 × 10⁴ years
 C 1.58 × 10⁴ years
 D 1.95 × 10⁴ years

- 25 The properties of the oxides of four Period 3 elements **W**, **X**, **Y** and **Z** are given below.
- The oxide of **W** is insoluble in water and in dilute acid but soluble in concentrated sodium hydroxide.
 - The oxide of **X** is amphoteric.
 - The oxide of **Y** reacts with dilute potassium hydroxide at room temperature.
 - The oxide of **Z** dissolves in water to form a solution of pH = 13.

Which of the following is correct in order of increasing atomic number?

- A Z, X, W, Y
 B W, X, Y, Z
 C Z, W, X, Y
 D Z, Y, W, X

- 26 Norcarane undergoes free radical substitution with limited bromine in the presence of ultraviolet light to form mono-brominated compound **Y**.



Norcarane

How many isomers of **Y** (including stereoisomers) will be formed at the end of the reaction?

- A 3 B 4 C 6 D 8

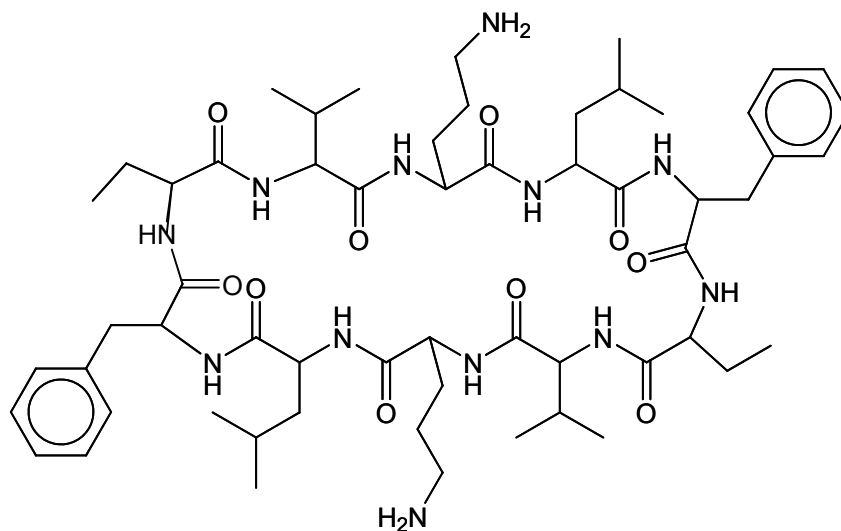
- 27 The following are information for a reaction involving **X** and **Y**:
- it is first order with respect to **[X]** and zero order with respect to **[Y]**.
 - its rate constant doubles for each 10 °C rise in temperature

Which of the following statements are true about this reaction?

- 1 The half-life of the reaction remains the same when **[X]** doubles.
- 2 The half-life of the reaction doubles when **[Y]** is halved.
- 3 When the temperature of the reaction increases from 298K to 318K, the rate of the reaction will be quadrupled.
- 4 The rate of the reaction will change when **[X]** is halved and temperature increases from 298K to 308K.

- A 1 and 2 only B 1 and 3 only C 1, 2 and 3 only D 2, 3 and 4 only

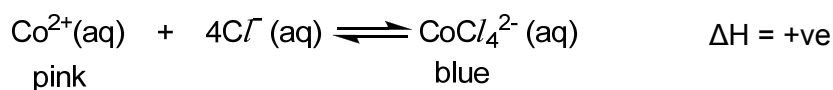
- 28 Gramicidin Soviet is an antibiotic that is effective against some fungi. It is made up of several α amino acids.



Gramicidin Soviet

Which statement about Gramicidin Soviet is correct?

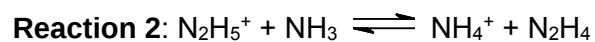
- A It is made up of 5 different amino acids.
 - B 1 mole of Gramicidin Soviet consists of 9 amide bonds.
 - C 1 mole of Gramicidin Soviet reacts with 10 moles of hot dilute H_2SO_4 .
 - D Upon reaction with hot dilute NaOH , the products formed have high melting point as they can form strong intermolecular hydrogen bonding.
- 29 A humidity meter is made by soaking filter paper in an aqueous solution of cobalt(II) ions in HCl (aq). The equation for the equilibrium reaction can be represented as follows:



Which of the following statements are correct?

- 1 On a very humid day, the filter paper will appear more pink.
 - 2 When the filter paper is diluted with more water, there will be no colour change.
 - 3 On a very hot day, the filter paper will appear more blue.
 - 4 When the filter paper is placed in a sealed container under high pressure, there will be no colour change.
- A 3 only B 2 and 4 only C 1, 3 and 4 only D 2, 3 and 4 only

30 The position of equilibrium lies to the right in each of these reactions.



Based on this information, which statements are correct?

- 1 Br^- is the conjugate base of HBr.
- 2 N_2H_5^+ is the Bronsted base in **Reaction 2**.
- 3 The order of acid strength is $\text{HBr} > \text{N}_2\text{H}_5^+ > \text{NH}_4^+$.
- 4 N_2H_4 is the Lewis acid in **Reaction 1**.

A 1 and 3 only **B** 1 and 4 only **C** 2 and 3 only **D** 2 and 4 only

~ END OF PAPER ~