ANGLO-CHINESE JUNIOR COLLEGE
DEPARTMENT OF CHEMISTRY
Preliminary Examinations

CHEMISTRY **9746/01**
Higher 2

Paper 1 Multiple Choice

26 August 2008

1 hour

Additional Materials: Multiple Choice Answer Sheet
Soft clean eraser
Soft pencil (type B or HB is recommended)
Data Booklet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.
Write your name, Centre number and candidate number on the answer sheet in the spaces provided unless this has been done for you.

There are **forty** questions in 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.

Read the instructions on the answer sheet very carefully.

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.

This document consists of **17** printed pages.

Section A

For each question there are four possible answers, **A**, **B**, **C**, and **D**. Choose the **one** you consider to be correct.

1 In an experiment, Mn^{2+} ions are oxidised by $S_2O_8^{2-}$ to form MnO_4^- according to the following equation.

$$2Mn^{2+}(aq) + 5S_2O_8^{2-}(aq) + 8H_2O(l) \rightarrow 2MnO_4^-(aq) + 10SO_4^{2-}(aq) + 16H^+(aq)$$

What volume of 0.100 mol dm^{-3} solution of acidified Mn^{2+} is required to reduce completely 25.0 cm^3 of 0.200 mol dm^{-3} of $Na_2S_2O_8$ solution?

A 10 cm^3 **B** 20 cm^3 **C** 30 cm^3 **D** 50 cm^3

2 In an experiment, 50 cm^3 of a 0.1 mol dm^{-3} solution of a metallic salt reacted exactly with 25 cm^3 of 0.1 mol dm^{-3} aqueous sodium sulphite.

The half equation for the oxidation of the sulphite ion is shown below.

$$SO_3^{2-}(aq) + H_2O(l) \rightarrow SO_4^{2-}(aq) + 2H^+(aq) + 2e^-$$

If the original oxidation number of the metal in the salt was +3, what would be the **final** oxidation number of the metal?

A 0 **B** +1 **C** +2 **D** +4

3 10 cm^3 of a pure hydrocarbon was completely burned in 80 cm^3 of oxygen (an excess) at 425K. After cooling to room temperature, the volume of the gaseous mixture decreased by 105 cm^3 to 55 cm^3. A further reduction of 40 cm^3 was observed when the residual gas was passed through calcium hydroxide. All gas volumes were measured at the same temperature and pressure. What is the formula of the hydrocarbon?

A C_2H_6 **B** C_3H_8 **C** C_4H_{10} **D** C_5H_{12}

4 Which of the following electronic configurations represents an element that forms a simple ion with a charge of -3?

A $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^1$

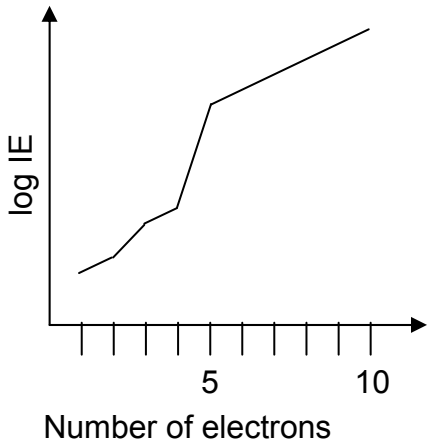
B $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^3$

C $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^1\ 4s^2$

D $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^3$

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

The graph shows the logarithm of the ionisation energy for the outermost ten electrons in an atom of an element **X**.



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

A silicon **B** magnesium **C** neon **D** phosphorous

6 Which one of the following species is **not** planar?

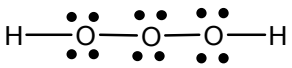
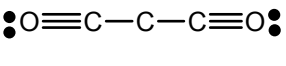
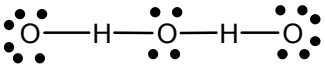
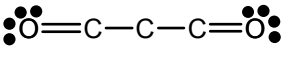
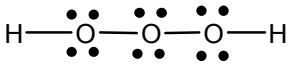
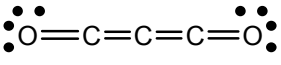
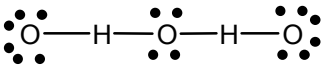
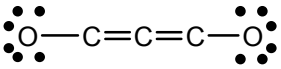
A XeF_4

B ICl_4^-

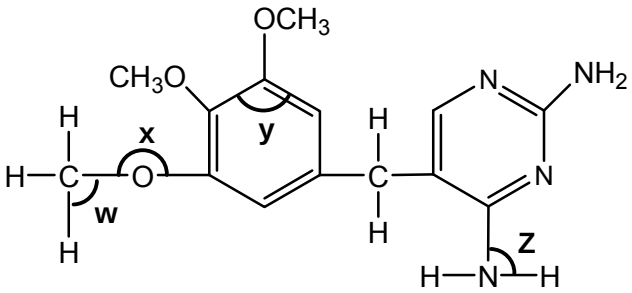
C C_2Cl_4

D PCl_4^+

7 Hydrogen trioxide, H_2O_3, is an unstable compound but can be isolated in small quantities. Carbon suboxide, C_3O_2, is a foul-smelling gas obtained by fully dehydrating propan-1,3-dioic acid. Which of the following shows reasonable Lewis structures for these two molecules?

	Hydrogen trioxide	Carbon suboxide
A		
B		
C		
D		

8 Trimethoprim (TMP) is used for the treatment and prevention of urinary tract infections, traveller's diarrhoea, respiratory and middle ear infections. It has the following structure:



Trimethyoprim (TMP)

In which sequence are the bond angles quoted in decreasing order?

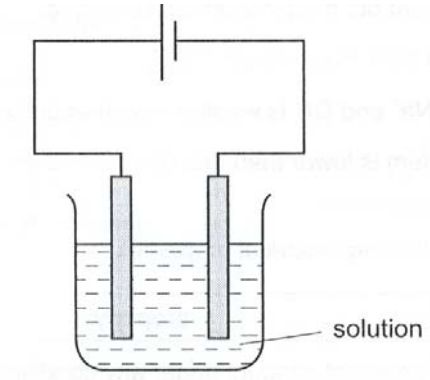
A x > y > w > z

B x > y > z > w

C y > z > w > x

D y > w > z > x

9 The diagram shows the electrolysis of a concentrated aqueous solution containing both copper(II) ions and sodium ions



Which metal is deposited at the negative electrode and why?

	metal deposited	**reason**
A	copper	copper is less reactive than sodium
B	copper	copper is more reactive than hydrogen
C	sodium	copper is less reactive than hydrogen
D	sodium	copper is more reactive than sodium

10 When a solution of concentrated sodium carboxylate is electrolysed, the equation for the reaction is

$$2RCO_2Na + 2H_2O \longrightarrow R\text{-}R + 2CO_2 + 2NaOH + H_2$$

Which statement regarding the electrolysis is **incorrect**?

A Hydrogen is liberated at the cathode.

B R-R is liberated at the cathode.

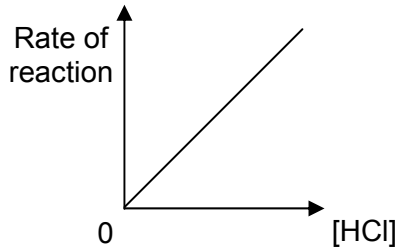
C Carbon dioxide is liberated at the anode.

D The solution around the cathode turns red litmus blue.

11 Ethyl ethanoate undergoes hydrolysis in water in the presence of HCl which catalysed the reaction.

Which of the following graphs would confirm that the rate of reaction is first order with respect to HCl?

A



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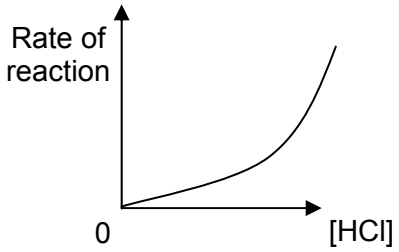
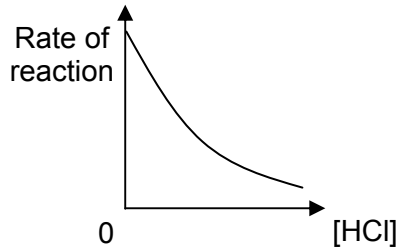
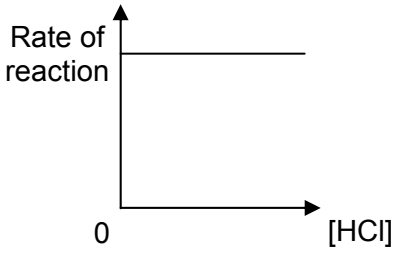


C



D



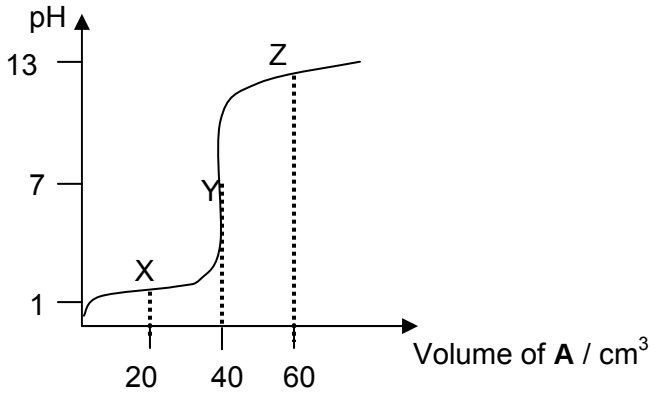
12 An equimolar mixture of A and B at an initial total pressure of 2 atm was allowed to reach equilibrium. The equation for the reaction is:

$$A(g) + 2B(g) \rightleftharpoons 2C(g)$$

At equilibrium the total pressure was reduced to 1.8 atm. What is the numerical value of K_p?

A 0.010 **B** 0.383 **C** 0.556 **D** 0.729

13 The following graph shows the pH changes when a 0.10 mol dm^{-3} solution of **A** is added to 20.0 cm^3 of 0.10 mol dm^{-3} of sulphuric acid.



Which statement regarding the titration is correct?

A Point X has maximum buffering capacity.

B At point Y the salt is hydrolysed to give an acidic solution.

C Point Z has maximum buffering capacity.

D The **A** is a strong base.

14 The value of the solubility product of strontium hydroxide is 3.0 x 10^{-4}. The mass of strontium hydroxide required to prepare 1 dm^3 of saturated solution is

A 3.0 x 10^{-4} x 121.6 g

B 3.0 x $10^{-4}/2$ x 121.6 g

C $\sqrt{3.0\times10^{-4}}$ x 121.6 g

D $\sqrt[3]{\frac{3.0\times10^{-4}}{4}}$ x 121.6 g

15 Which species represented by the following formulae has the largest radius?

A P^{3-} **B** Cl^- **C** Ar **D** K^+

16 Which statement concerning the third period elements sodium to argon and their compounds is **not correct**?

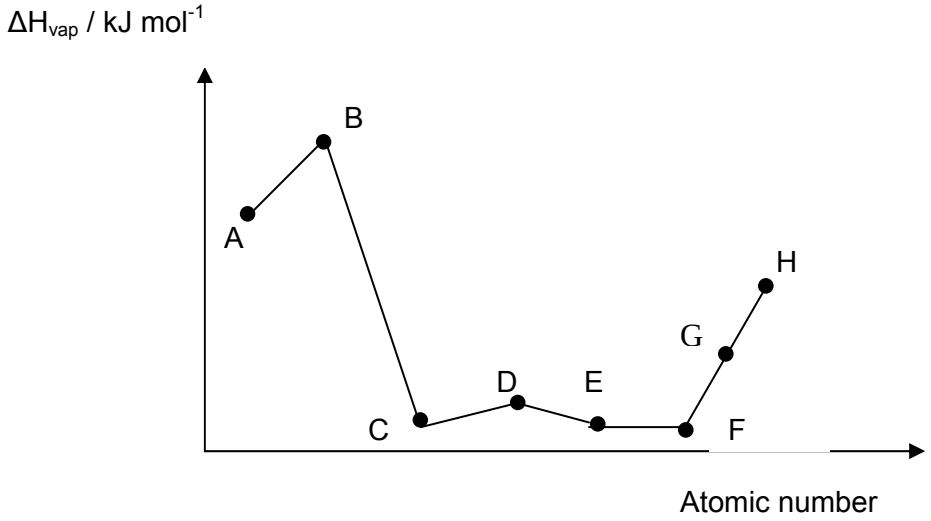
A The elements become more electronegative from sodium to chlorine.

B The atomic radius of the elements decrease from sodium to chlorine.

C Aluminium oxide is the only oxide which is insoluble in water.

D The highest oxidation state is shown by chlorine.

17 The graph below show the variation in the molar enthalpy change of vapourisation, ΔH_{vap} for 8 consecutive elements in the Periodic Table, all with atomic number ≤ 20.



What can be deduced from the above graph?

A Element A forms amphoteric oxides.

B Element C is in the same group as boron in the Periodic Table.

C Element F exists as diatomic molecules.

D Element G forms an oxide which is acidic in aqueous solution.

18 Beryllium dichloride, $BeCl_2$, reacts with methylamine, CH_3NH_2 to form a compound. Which one of the statements is **incorrect**?

A The compound is formed from 1 mole of $BeCl_2$ and 2 moles of CH_3NH_2.

B The Be-N bond formed is chemically similar to a covalent bond.

C The compound is capable of forming only two hydrogen bonds per molecule.

D The beryllium atom in beryllium dichloride is electron deficient.

19 Which of the following properties of the Group II elements increases with increasing atomic number?

A Melting point of the element.

B Reducing power of the element.

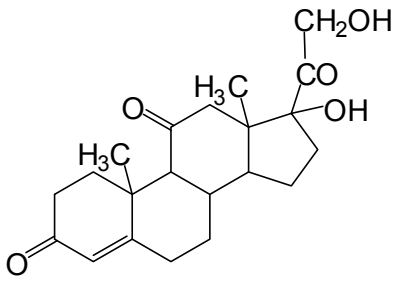
C Electronegativity of the element.

D First ionisation energy of the element.

20 All isomeric aromatic carbonyl compounds with the molecular formula, C_8H_8O are added separately to warm alkaline solution of copper(II) tartrate.
How many of these isomers will give a red precipitate?

A 0 **B** 1 **C** 2 **D** 3

21 Cortisone is a drug that has the following formula:



Which of the following reagents **does not** react with cortisone?

A Na_2CO_3

B $SOCl_2$

C Br_2

D $KMnO_4/H^+$

22 A student was told to carry out the following experiment on iodobenzene, chloromethylbenzene and bromoethane.

The three organic compounds was boiled under reflux with aqueous sodium hydroxide, cooled and acidified with dilute nitric acid and aqueous silver nitrate was added.

What is the expected observation for each compound?

	Iodobenzene	**Chloromethylbenzene**	**Bromoethane**
A	Yellow ppt	White ppt	Cream ppt
B	No ppt	Cream ppt	White ppt
C	No ppt	White ppt	Cream ppt
D	Yellow ppt	No ppt	No ppt

23 Which of the following will **not** be formed when the compound $C_6H_5CH_2CH_2Cl$ reacts with hot ethanolic KOH?

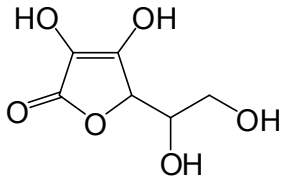
A $C_6H_5CH{=}CH_2$

B $C_6H_5CH_2CH_2OCH_2CH_3$

C C_6H_5COOH

D $C_6H_5CH_2CH_2OH$

24 The structure of Vitamin C is given below.



Vitamin C

Which one of the following statements is **correct**?

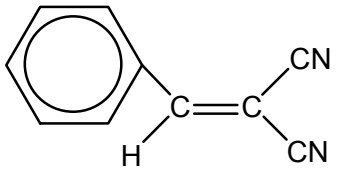
A It exhibits geometric isomerism.

B It reacts with 5 moles of aqueous sodium hydroxide.

C It can react with 2, 4-dinitrophenylhydrazine to form bright orange crystals.

D It can react with hot aqueous hydrochloric acid.

25 The structure below is that of CS tear gas, a substance that is used in spray form by many police forces to control riots.

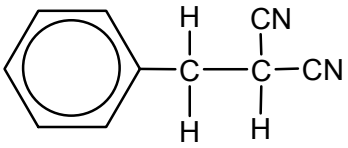
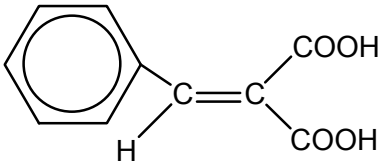
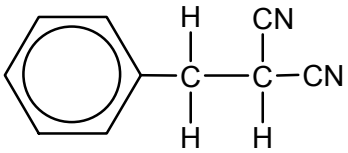
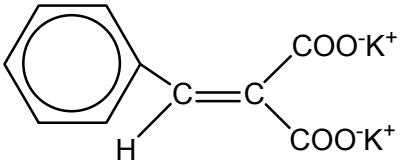
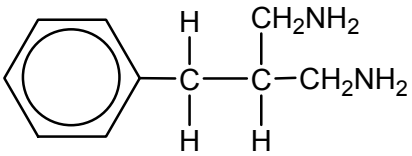
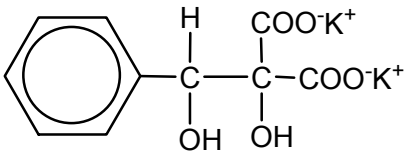
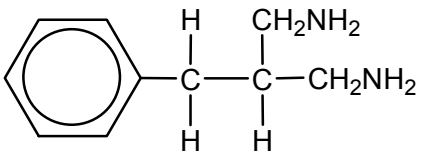
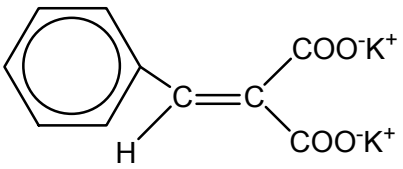


The above compound was reacted separately with the following reagents and conditions

I) Hydrogen gas in the presence of nickel catalyst under high pressure and high temperature

II) Hot aqueous potassium hydroxide.

Which of the following shows the organic compound found in each reaction?

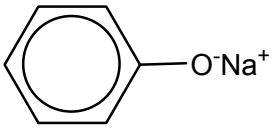
	I) $H_2(g)$ / Ni under high temperature and pressure	**II) Hot KOH(aq)**
A		
B		
C		
D		

26 **P**, **Q** and **R** are three isomeric aromatic compounds with the molecular formula, $C_8H_8O_2$.

P and **Q** are monobasic acids whereas **R** is a neutral compound.

The pK_a of **P** and **Q** are 3.90 and 4.31 respectively.

When **R** is heated strongly with NaOH, one of the organic products yielded is



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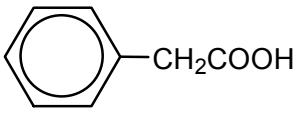
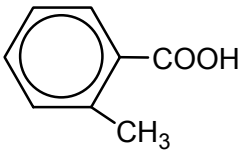
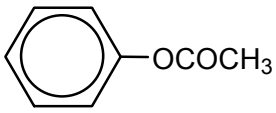
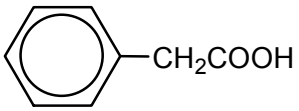
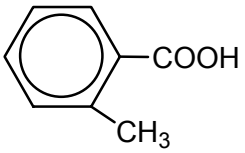
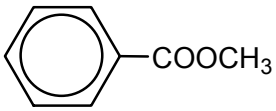
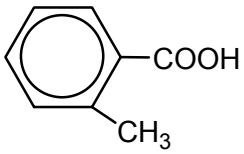
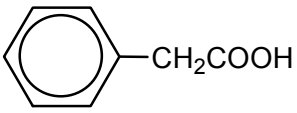
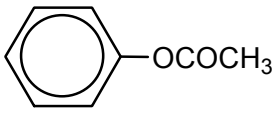
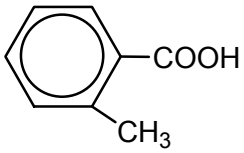
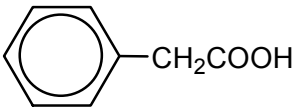
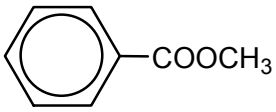
Which of the following shows the correct identity of **P**, **Q** and **R** ?

	P	**Q**	**R**
A			
B			
C			
D			

27 Which of the following is the correct order of **increasing** pK_b values?

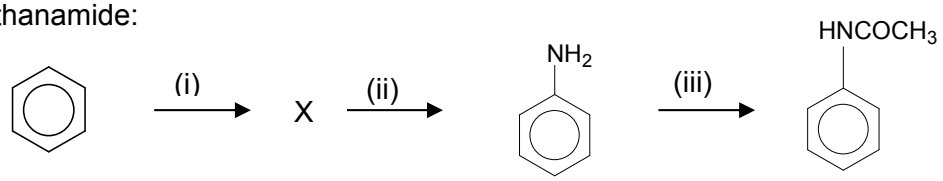
A 4-chlorophenylamine, 4-nitrophenylamine, 4-methylphenylamine, phenylamine

B 4-methylphenylamine, phenylamine, 4-chlorophenylamine, 4-nitrophenylamine

C 4-nitrophenylamine, 4-methylphenylamine, phenylamine, 4-chlorophenylamine

D phenylamine, 4-chlorophenylamine, 4-nitrophenylamine, 4-methylphenylamine

28 The following reaction scheme shows the conversion of benzene to N-phenylethanamide:

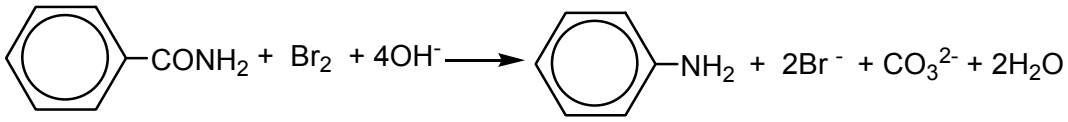


The reagents for steps (i), (ii) and (iii) are as follows:

	(i)	(ii)	(iii)
A	Conc HNO_3, conc H_2SO_4	Sn, conc HC*l*	Ethanoic acid
B	Dilute aq HNO_3	$LiAlH_4$ in dry ether	Ethanoyl chloride
C	Conc HNO_3, conc H_2SO_4	H_2, Pt	Ethanoyl chloride
D	Dilute aq HNO_3	Sn, conc HC*l*	Ethanoic acid

29 When treated with bromine and sodium hydroxide solution, amides can be converted to amines by a process known as Hofmann's degradation.

The overall reaction equation showing benzamide undergoing Hofmann's degradation is as follows:



Which one of the following shows the organic product when propylamide ($CH_3CH_2CONH_2$) undergoes Hofmann's degradation?

A CH_3NH_2

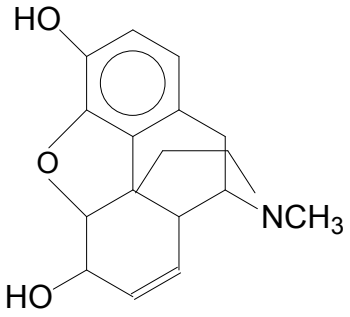
B $CH_3CH_2NH_2$

C $CH_3CH_2CH_2NH_2$

D $CH_3CH_2CH_2CH_2NH_2$

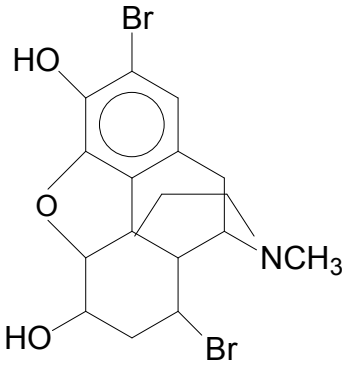
30 The structure of morphine is shown below.

Morphine

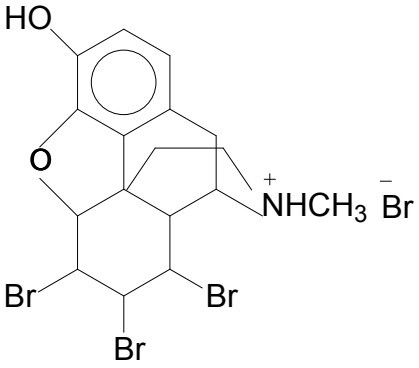


The reaction between morphine and dry HBr (g) gives

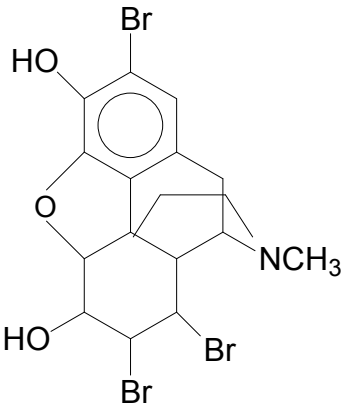
A



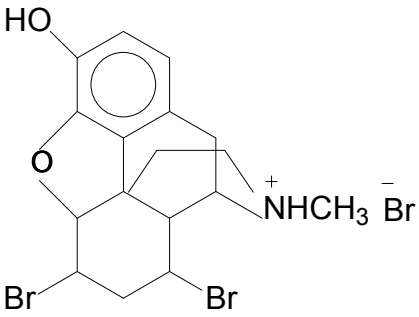
B



C



D



Section B

For each of the questions in this section, one or more of the three numbered statements **1** to **3** may be correct.

Decide whether each of the statements is or is not correct (you may find it helpful to put a tick against the statements that you consider to be correct).

The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, **2** and **3** are correct	**1** and **2** only are correct	**2** and **3** only are correct	**1** only is correct

No other combination of statements is used as a correct response.

31 Which of the following gaseous ions have the same number of unpaired electrons in its ground state?

1 Co^{2+}

2 V^{2+}

3 Cr^{3+}

32 In oil refineries, an important process is the recovery of any sulphur from petroleum.

$$2H_2S(g) + O_2(g) \rightarrow 2H_2O(g) + 2S(s)$$

The enthalpy change of formation of $H_2S(g)$ is -20.5 kJ mol^{-1} and that of $H_2O(g)$ is -243.0 kJ mol^{-1}.

Which statements are true?

1 The above reaction is thermodynamically feasible only at low temperatures.

2 Enthalpy change of combustion of H_2S is -445 kJ mol^{-1}.

3 Enthalpy change of above reaction can be calculated from bond energy data of reactants and products.

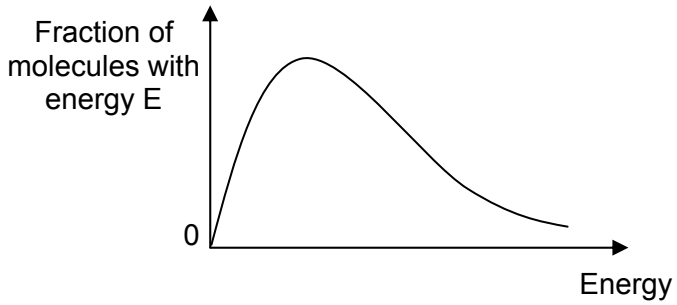
33 Which of the following series show an **increasing** trend in boiling points?

1 $CH_3CH_2OCH_3$ < CH_3CH_2CHO < $HOCH_2CH_2OH$

2 AlF_3 < $AlBr_3$ < AlI_3

3 $CH_3CH_2CH_2Cl$ < $CH_3CH_2CH_2F$ < CH_3COOH

34 The diagram below represents the Boltzmann Distribution of molecular energies at a given temperature.



On the addition of a catalyst, which of the following statements are **incorrect**?

1 At all energies, the proportion of molecules increases.

2 The proportion of molecules with energies above a given value increases.

3 The maximum of the curve is displaced to the right.

35 The standard redox potential for the electrode

$$[2NO_3^-(aq) + 10H^+(aq)], [N_2O(g) + 5H_2O(l)] \mid Pt$$

is at +1.1 V at pH 0.

Which statements are correct?

1 The redox potential varies with pH.

2 The oxidation state of nitrogen changes from +5 to +1.

3 The value of the standard redox potential is expressed relative to that of the standard hydrogen electrode.

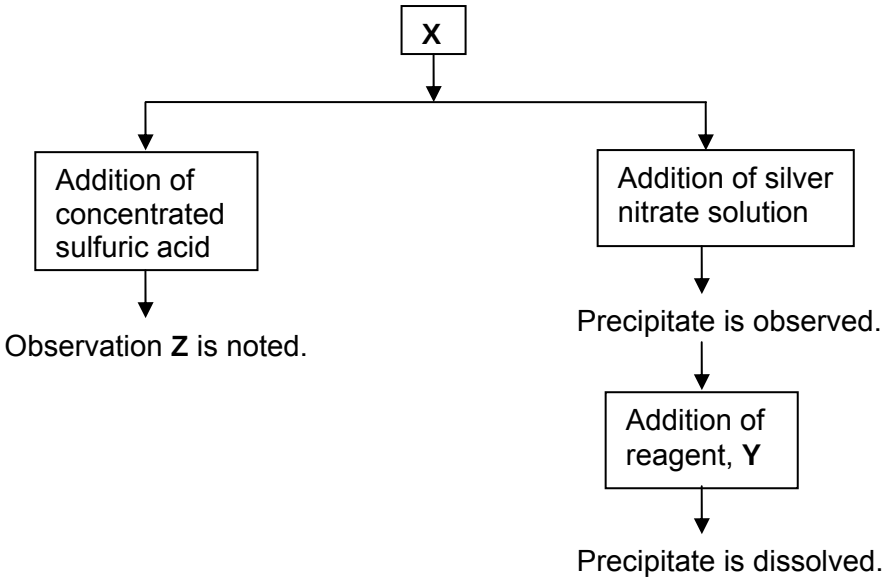
36 Which of the following will react with aqueous sodium hydroxide?

1 $C_6H_5CH_2CN$

2 $CH_3CONHCH_3$

3 $CH_3CH_2NH_2$

37 The flowchart below shows the reaction of an unknown Group VII compound or element, **X**.

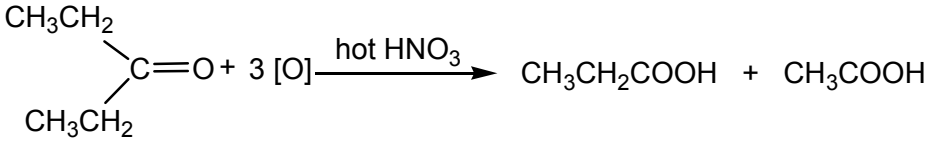


	X	Y	observation Z
1	Chlorine gas	Aqueous ammonia	Yellow fumes observed
2	Potassium chloride	Aqueous ammonia	White fumes observed
3	Potassium bromide	Concentrated ammonia	Reddish brown fumes observed

38 Ketones are generally resistant to oxidation.

With vigorious oxidation using hot nitric acid, ketones can be oxidised to acids.

The chemical equation showing the oxidation of penta-3-one is as follows.



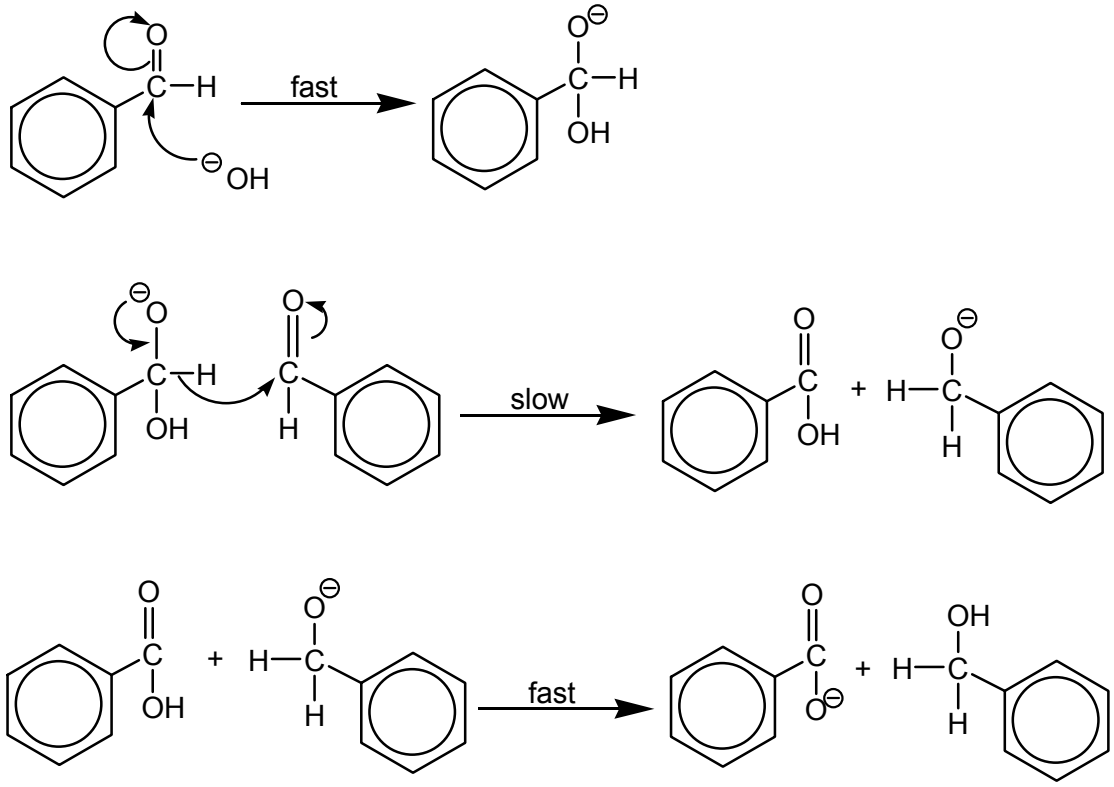
What are the products formed when propanone undergoes the same type of oxidation?

1 carbon dioxide

2 ethanoic acid

3 methanoic acid

39 The mechanism of Cannizzaro reaction involving benzaldehyde is as follows:



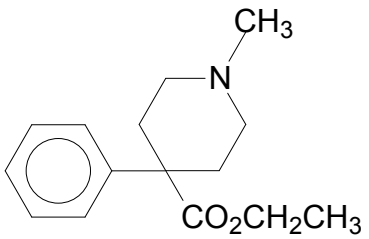
Which of the following type(s) of reaction(s) is/are illustrated by the above mechanism?

1 acid-base reaction

2 disproportionation

3 nucleophilic addition

40 Pethidine, a local anaesthetic, has the following structure:



Which statement(s) concerning pethidine is/are correct?

1 One of the products of hydrolysis reacts with aqueous iodine and sodium hydroxide to give yellow crystals.

2 It is reduced by $LiAlH_4$.

3 It reacts with dilute hydrochloric acid at room temperature.

END OF PAPER