INNOVA JUNIOR COLLEGE
JC 2 PRELIMINARY EXAMINATIONS 2
in preparation for General Certificate of Education Advanced Level
**Higher 2**

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|---|---|---|---|
| CANDIDATE NAME | | | |
| CLASS | | INDEX NUMBER | |

# CHEMISTRY 9746/01

Paper 1 Multiple Choice **17 September 2008**

**1 hour**

Additional Materials: Data Booklet
Multiple Choice Answer Sheet.

**READ THESE INSTRUCTIONS FIRST**

Write your name and class on all the work you hand in.
Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.

There are **forty** 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.

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 **15** printed pages and **1** blank 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** Acidified aqueous potassium dichromate(VI) oxidizes ethanedioate ions, $C_2O_4^{2-}$, to $CO_2$.

What volume of 0.020 mol $dm^{-3}$ potassium dichromate(VI) is required to oxidize completely 1.0 x $10^{-3}$ mol of the salt $KHC_2O_4 \cdot H_2C_2O_4$?

**A** 17 $cm^3$ **C** 50 $cm^3$

**B** 33 $cm^3$ **D** 125 $cm^3$

**2** Nervous disorders due to mercury poisoning occur when mercury forms a 1:1 complex with lipoyl groups, which are vital for glucose metabolism.

For a human containing 3.0 kg of body fluid, what is the mass of mercury ($A_r$ 200) required to complex all the lipoyl groups? [Average concentration of lipoyl groups in body fluid = 1.0 x $10^{-8}$ mol $kg^{-1}$]

**A** 1.5 x $10^{-9}$ g **C** 6.0 x $10^{-8}$ g

**B** 3.0 x $10^{-8}$ g **D** 6.0 x $10^{-6}$ g

**3** When methane, $CH_4$, was burned in an incorrectly adjusted burner, it was converted into a mixture of carbon dioxide and carbon monoxide in the ratio 99:1, together with water vapour.

What is the volume of oxygen consumed when 4 $dm^3$ of methane is burned?

**A** 7.98 $dm^3$ **C** 3.98 $dm^3$

**B** 7.96 $dm^3$ **D** 3.96 $dm^3$

**4** Tritium, ${}^3_1H$ , is an isotope of hydrogen atom.

Given that a 2 g sample of hydrogen at temperature *T* and volume *V* exerts a pressure *p*, which of the following would also exert a pressure *p* at the same temperature *T*?

**A** a mixture of 1 g of hydrogen and 1 g of tritium of total volume 3*V*

**B** a mixture of 3 g of hydrogen and 1 g of tritium of total volume *V*

**C** a mixture of 1 g of hydrogen and 3 g of tritium of total volume *V*

**D** a mixture of 3 g of hydrogen and 1 g of tritium of total volume *3V*

**5** Which of the following atoms or ions has 1 unpaired electron?

**A** $N^-$

**B** O

**C** $S^{2-}$

**D** $Zn^+$

**6** Which of the following molecules **do not** have all the atoms lying on the same plane?

**A** $H_2O$

**B** $ICl_3$

**C** $PH_3$

**D** $BrCl_4$-

**7** Why is ethanol more soluble than ethyl ethanoate in water?

**A** A hydrogen bond forms between the hydrogen of the –OH group in ethanol and the hydrogen of a water molecule.

**B** A hydrogen bond forms between the hydrogen of the –OH group in the ethanol and the oxygen of a water molecule.

**C** Ethanol is a polar molecule, but ethyl ethanoate is non-polar.

**D** Ethanol is able to dissociate into hydrogen ions and ethoxide ions, but ethyl ethanoate is not able to dissociate.

**8** **S** and **Q** are two isotopes of a radioactive element, with half-lives of 5 min and 10 min respectively. An experiment begins with equal number of radioactive atoms of **S** and **Q** which decay to give **S'** and **Q'** respectively. How long will it take for **S'**:**Q'** ratio to be 5:4, given that the radioactive decay is a first-order reaction?

**A** 10 min

**B** 20 min

**C** 30 min

**D** 40 min

**9** Nitrogen, being an unreactive gas, is frequently used as an inert atmosphere.

Which of the following gives the best explanation for its unreactivity?

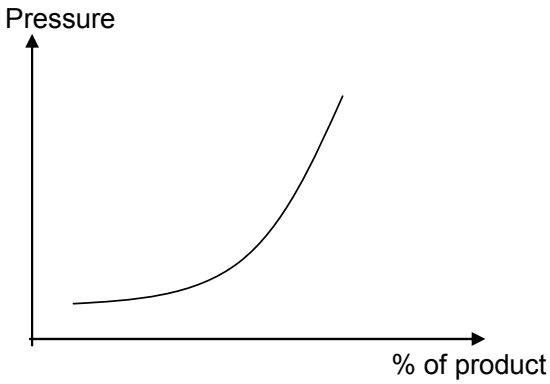
**A** Its molecule contains a triple bond.

**B** The three p-orbitals of nitrogen are fully-filled.

**C** The bond in its molecule is short (0.110 nm).

**D** The bond energy of the molecule is high (994 kJ $mol^{-1}$).

**10**




Which of the following reaction will have the graph shown above?

**A** $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$

**B** $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

**C** $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$

**D** $N_2O_4(g) \rightleftharpoons 2NO_2(g)$

**11** The enthalpy change of reaction between calcium and water, $\Delta H_r$, can be measured in the laboratory.

$Ca(s) + 2H_2O(l) \rightarrow Ca(OH)_2(s) + H_2(g)$; $\Delta H_r$

What other data is needed in order to calculate the enthalpy change of formation of $Ca(OH)_2(s)$?

**A** Enthalpy change of atomisation of calcium

**B** Enthalpy change of combustion of hydrogen

**C** First and second ionisation energies of calcium

**D** Lattice energy of calcium hydroxide

**12** The solubility of barium sulphate is 0.0025 g $dm^{-3}$. What mass of barium sulphate can be dissolved in 2.0 $dm^3$ of 0.0200 mol $dm^{-3}$ of sulphuric acid? (Mr of $BaSO_4$ = 233.1)

**A** $2.68 \times 10^{-6}$ g

**B** $1.34 \times 10^{-6}$ g

**C** $0.68 \times 10^{-6}$ g

**D** $0.34 \times 10^{-6}$ g

**13** A current was passed through two cells connected in series. The first cell contained molten magnesium chloride while the other contained molten chromium (III) chloride. If 4.8 g of magnesium was liberated from the first cell, the mass of chromium liberated from the other cell will be

**A** 2.4 g

**B** 3.2 g

**C** 6.8 g

**D** 15.6 g

**14** A tiny magnesium electrode which creates an electrical cell with inhaled oxygen could be used in the construction of heart pacemakers.

From the relevant half-cells:

$Mg^{2+} + 2e \rightleftharpoons Mg$ $\quad E^{\theta} = -2.38$ V

$\frac{1}{2}O_2 + 2H^+ + 2e \rightleftharpoons H_2O$ $\quad E^{\theta} = +1.23$ V

the cell e.m.f would be +3.61V under standard conditions. However, in the body, a potential of +3.25V is more common. Which of the following gives the best explanation for this lower e.m.f?

**A** the small size of the magnesium electrode

**B** the low concentration of $Mg^{2+}$ ions surrounding the magnesium electrode

**C** the high resistance of the body fluids surrounding the electrodes

**D** the pH of between 7 and 8 of the body fluid surrounding the electrodes

**15** Three types of oxides required to make coloured glass in church windows are one macromolecular, one ionic and one of a transition metal. Which of the following combinations of oxides is likely to produce a coloured glass?

**A** $Al_2O_3$, MgO, SnO

**B** $SiO_2$, CaO, PbO

**C** $P_4O_{10}$, CaO, CuO

**D** $SiO_2$, PbO, CoO

**16** Which one of the following statements about Group II elements (Be to Ba) is correct?

**A** The reactivity with cold water decreases down Group II metals.

**B** The charge density of Group II cations increases from Be to Ba.

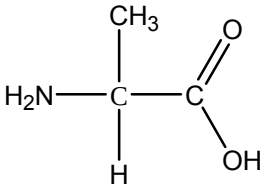
**C** The solubility of the sulphates increases from Be to Ba.

**D** The thermal stability of the Group II carbonate increases from Be to Ba.

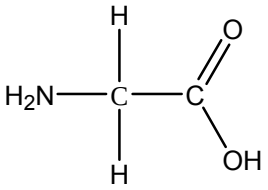
**17** For which one of the following metal complexes is the electronic configuration wrong?

| | Complex | Electronic configuration of central metal ion |
|---|---|---|
| **A** | $[Zn(NH_3)_4]^{2+}$ | [Ar] $3d^{10}$ |
| **B** | $[Co(H_2O)_6]^{3+}$ | [Ar] $3d^{6}$ |
| **C** | $[Cu(NH_3)_4]^{2+}$ | [Ar] $3d^{10}$ |
| **D** | $[Ni(CN)_6]^{4-}$ | [Ar] $3d^{8}$ |

**18** How many different tripeptides can be formed from glycine and alanine amino acids?




alanine




glycine

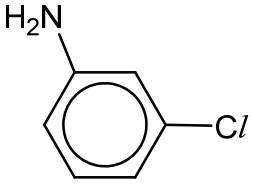
**A** 3

**B** 4

**C** 5

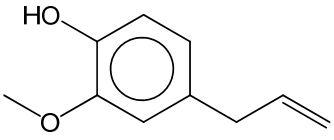
**D** 6

**19** Which one of the following methods would you choose for the synthesis of the compound shown below starting from benzene?

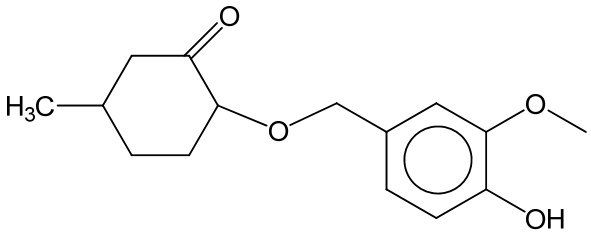



| | First step | Second step | Third step |
|---|---|---|---|
| **A** | Nitration | Chlorination | Reduction |
| **B** | Nitration | Reduction | Chlorination |
| **C** | Oxidation | Chlorination | Nitration |
| **D** | Chlorination | Nitration | Oxidation |

**20** Eugenol is an ally chain-substituted guaiacol found in essential oils and ginerol is found in ginger used for its antibacterial properties.




Eugenol




Ginerol

Which reagent can be used to distinguish eugenol from ginerol?

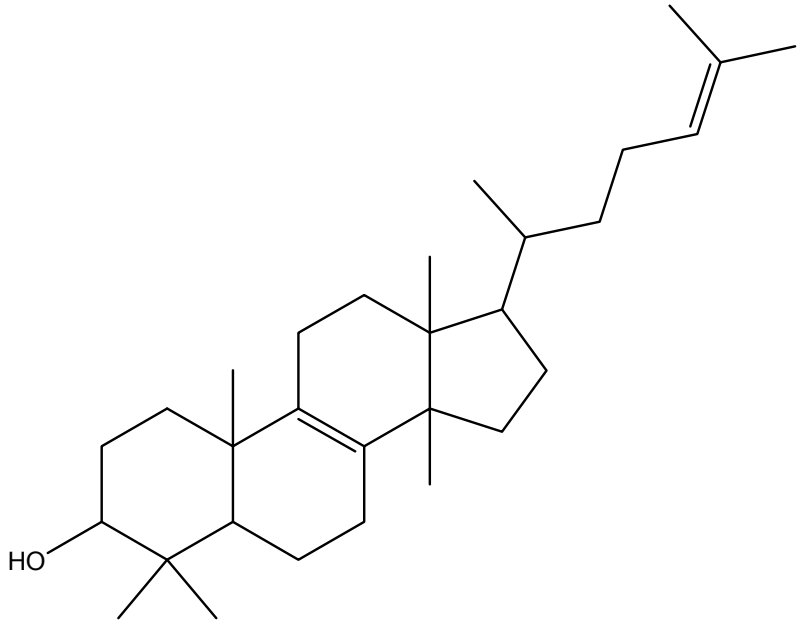
**A** Neutral $FeCl_3$

**B** HBr

**C** Fehling's reagent

**D** Acidified $KMnO_4$

**21** *Lanosterol* is a tetracyclic triterpenoid which is the compound from which all steroids are derived. It has the following structure.




How many stereoisomers does *Lanosterol* have?

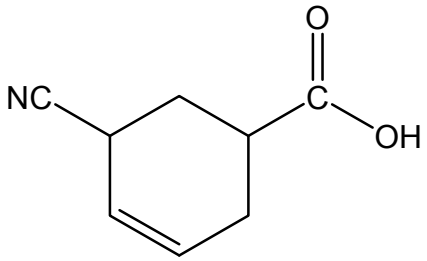
**A** 128
**B** 256
**C** 512
**D** 1024

**22** Which pairs of reactions could have the same common intermediate?

**E** $CH_3CO_2CH(CH_3)_2 \longrightarrow$ intermediate $\longrightarrow CH_3CHBrCH_3$
**F** $CH_3CH{=}CH_2 \longrightarrow$ intermediate $\longrightarrow CH_3CH(CN)CH_3$
**G** $CH_3CH_2COOH \longrightarrow$ intermediate $\longrightarrow CH_3CH_2CH_2Cl$
**H** $CH_3CHClCH_3 \longrightarrow$ intermediate $\longrightarrow CH_3COCH_3$

**A** **E** and **F**
**B** **E** and **G**
**C** **E** and **H**
**D** **H** and **G**

**23** Compound **M** has the structure as shown below.




How many sigma ($\sigma$) and pi ($\pi$) bonds does the compound **M** have?

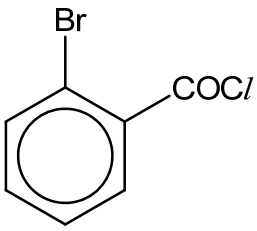
**A** 20 $\sigma$ and 4 $\pi$

**B** 12 $\sigma$ and 4 $\pi$

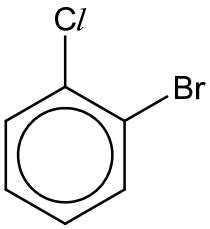
**C** 18 $\sigma$ and 2 $\pi$

**D** 12 $\sigma$ and 2 $\pi$

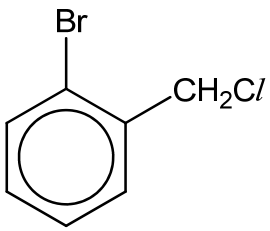
**24** Experiments are carried out on three compounds.




**X**




**Y**




**Z**

To 0.010 mol samples of each of **X**, **Y** and **Z** is added 10cm$^3$ of water and the samples are shaken and held at a fixed temperature for 2 days.

An excess of aqueous silver nitrate is then added to each sample and the precipitate produced is filtered off, washed, dried and weighed. The three samples of precipitate weigh 0.000 g, 0.014 g and 1.430 g.

Which sequence of compounds matches these results?

| | 0.000 g | 0.014 g | 1.430 g |
|---|---|---|---|
| **A** | **X** | **Y** | **Z** |
| **B** | **Y** | **Z** | **X** |
| **C** | **Y** | **X** | **Z** |
| **D** | **Z** | **Y** | **X** |

**25** When a nonapeptide (containing nine amino acid residues) isolated from rat brains was hydrolysed, it gave the following smaller peptides as identifiable products:

Gly-Ala-Phe
Ala-Leu-Val
Gly-Ala-Leu
Phe-Glu-His
His-Gly-Ala

Construct the amino acid sequence in the nonapeptide.

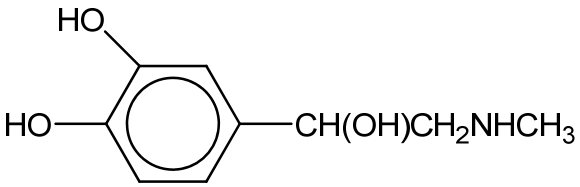
**A** Gly-Ala-Leu-Val-Phe-Glu-His-Gly-Ala

**B** Phe-Glu-His-Gly-Ala-Leu-Val-Gly-Ala

**C** Gly-Ala-Phe-Glu-His-Gly-Ala-Leu-Val

**D** His-Gly-Ala-Phe-Glu-His-Leu-Val-Gly

**26** Adrenaline has the following structure.




What reacts completely with 1 mol of adrenaline?

**A** 2 mole of $Br_2$

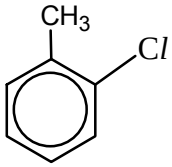
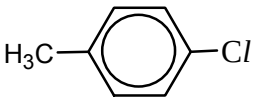
**B** 3 mole of $PCl_5$

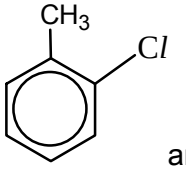
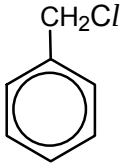
**C** 3 mole of NaOH

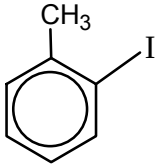
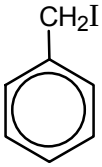
**D** 4 mole of $CH_3COCl$

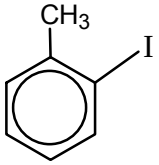
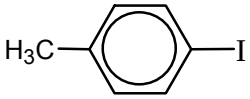
**27** Iron filings were added to a solution containing equimolar quantities of methylbenzene and iodochloride, IC*l*. The mixture was immediately placed in the dark until no further change took place.

Which of the following are likely to have been the main products?

**A**  and 

**B**  and 

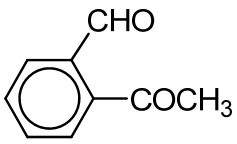
**C**  and 

**D**  and 

**28** The table shows the result of simple tests on a compound **T**.

| reagent | result |
|---|---|
| 2,4-dinitrophenylhydrazine | positive |
| alkaline aqueous iodine | positive |
| Fehling's reagent | negative |

From the result of the tests, what could **T** be?

**A** 

**B** $CH_3COCH_2CHO$

**C** $CH_3CH(OH)COOH$

**D** $CH_3COOCH_2CH_3$

**29** How many chiral compounds is it possible to prepare by subjecting ethane to repeated substitution by chlorine?

**A** 0 **C** 2

**B** 1 **D** 3

**30** Which reaction yields an organic compound having a chiral centre? [D = $^2$H]

**A** $CH_3CH_2Cl \xrightarrow[\text{Heat}]{\text{NaOD}}$

**B** $CH_3COOCHCl_2 \xrightarrow[\text{heat}]{\text{Dilute } D_2SO_4}$

**C** $CH_3CH_2CHO \xrightarrow[\text{Dry Ether}]{\text{LiA}lD_4}$

**D** $CH_3COCH_3 \xrightarrow[\text{NaCN in } D_2O]{\text{DCN}}$

## 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 statement 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, B, C,** and **D** should be selected on the basis of

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

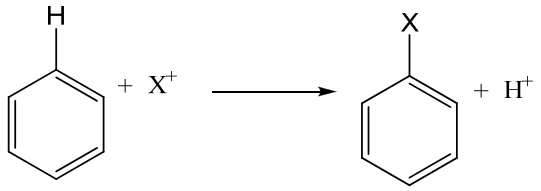
**31** Which of the following pairs of compounds do the first member have a smaller boiling point than the second member

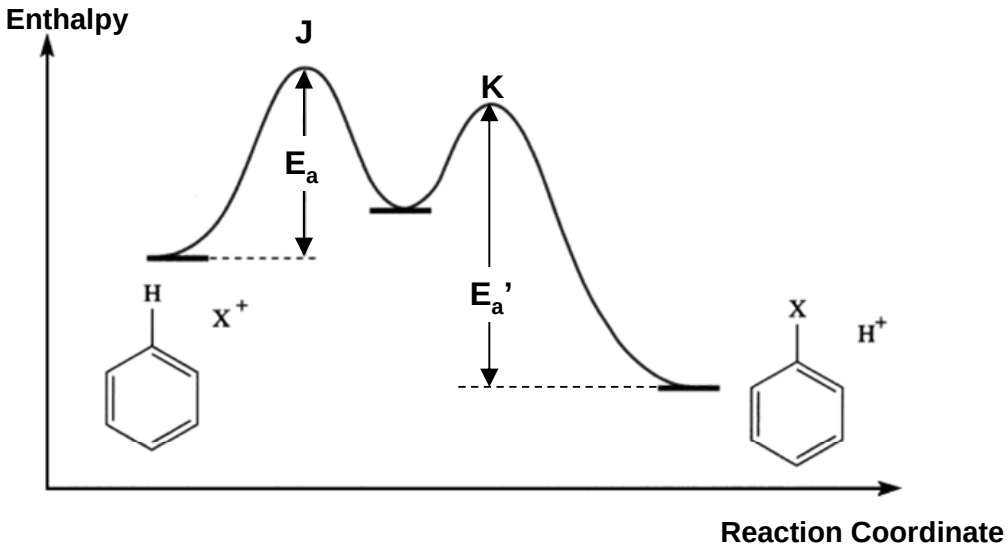
**1** $CO_2$, $CS_2$

**2** HBr, HF

**3** 2-nitrophenol, 3-nitrophenol

**32** For the reaction,




which of the following statements about the reaction are true?

**1** $E_a$' is the activation energy of the overall reverse reaction.

**2** The first step is the rate determining step.

**3** **J** and **K** are the intermediates of the reaction.

The responses **A, B, C,** and **D** should be selected on the basis of

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

**33** Which of the following reactions have a negative $\Delta H$ value?

**1** $Cl(g) + e \rightarrow Cl^-(g)$

**2** $2Cl\bullet(g) \rightarrow Cl_2(g)$

**3** $Cl_2(g) \rightarrow 2Cl(g)$

**34** The explosion at the Chernobyl nuclear power plant in 1986 could be due to the graphite reactor being overheated and reacted with the cooling water as follows.

$C(s) + H_2O(g) \rightleftharpoons H_2(g) + CO(g)$; $\Delta H = +131$ kJ mol$^{-1}$

What are the possible reasons why the forward reaction is more likely to occur at high temperature?

**1** Hydrogen and carbon monoxide do not react at high temperature.

**2** At lower temperature, the position of equilibrium lies too far to the left.

**3** The activation energy is high.

**35** Which of the following are correct descriptions of a weak acid?

**1** It has low $pK_a$ value.

**2** It has a relatively low electrical conductivity in dilute solutions.

**3** Its conjugate base is strong.

**36** Which of the following statements are true about the trends in the properties of the Group VII elements ($Cl_2$ to $I_2$)?

**1** The oxidising power decreases down the group.

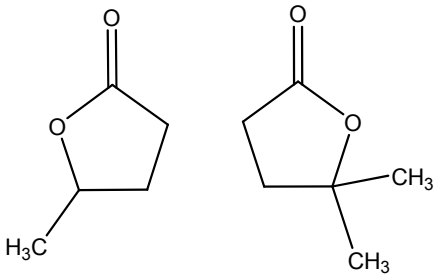
**2** The electronegativity decreases down the group.

**3** The volatility increases down the group.

The responses **A, B, C,** and **D** should be selected on the basis of

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

**37** Below are the structures of compounds **V** and **W.**




**V** **W**

Which sets of reagents and conditions can be used to distinguish the two compounds?

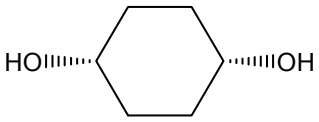
**1** Aqueous alkaline iodine, heat

**2** Acidified $KMnO_4$, reflux

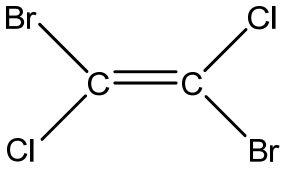
**3** 2, 4 - Dinitrophenylhydrazine

**38** Which of the following are most likely to have net dipole moments?

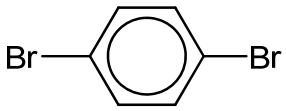
**1**




**2**




**3**



The responses **A, B, C,** and **D** should be selected on the basis of

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

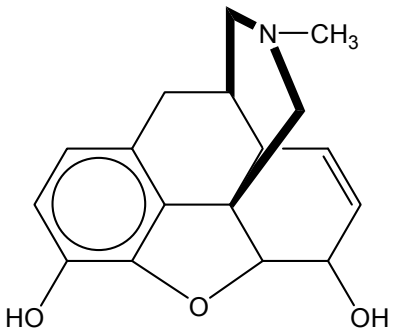
**39** Under what conditions will bromine react with methylbenzene?

**1** In the presence of sunlight

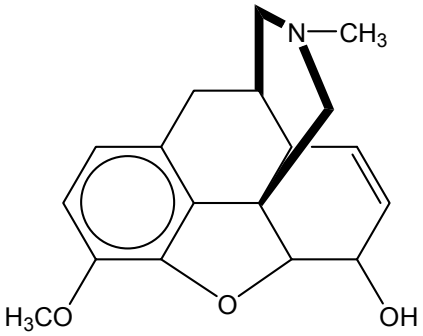
**2** In the presence of A*l*C*l*$_3$

**3** Dissolved in water in the dark

**40** Morphine and codeine are both effective painkillers. They have the following structure.




**morphine**




**codeine**

Which of the following statements of the two compounds are true?

**1** Both decolourises $Br_2$ in C*C*$l_4$.

**2** Both react with aqueous H*C*l.

**3** Both react with aqueous NaOH.

**End of Paper**