NANYANG JUNIOR COLLEGE
JC 2 PRELIMINARY EXAMINATION
Higher 2

CHEMISTRY 9746/01

Paper 1 Multiple Choice **17 September 2008**

1 hour

Additional Materials: Multiple Choice Answer Sheet
Data Booklet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.
Write your name, class and tutor's name on the Answer Sheet in the spaces provided unless this has been done for you.

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 you 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.

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 attempt to establish the formula of an oxide of nitrogen, a known volume of the pure gas was mixed with hydrogen and passed over a catalyst at a suitable temperature. 100% conversion of the oxide to ammonia and water was shown to have taken place.

$$N_xO_y \xrightarrow{H_2(g)} xNH_3 + yH_2O$$

2400 cm^3 of nitrogen oxide measured at room temperature and pressure produced 7.20 g of water. The ammonia produced was neutralized by 200 cm^3 of 1.0 mol dm^{-3} of HC*l*.

What is the oxidation number of the nitrogen in the nitrogen oxide?

A +1

B +2

C +3

D +4

2 Which one of the following ions has more electrons than protons, and more protons than neutrons?

[D= ^2_1H]

A D^- **B** He^+ **C** OH^- **D** D_3O^+

3 Which one of the following molecules is planar?

A NF_3

B C_2Cl_4

C SF_6

D cyclohexane, C_6H_{12}

4 Pyrogallol is a white crystalline powder and a powerful reducing agent that is used to absorb oxygen. When 30 cm^3 of a gaseous hydrocarbon is exploded with 200 cm^3 of oxygen, there is a contraction of 90 cm^3. On further treatment with alkaline pyrogallol, there was a reduction of 20 cm^3.

What is the molecular formula of the hydrocarbon? (All volumes are measured at room temperature pressure).

A C_4H_8 **B** C_4H_{10} **C** C_3H_8 **D** C_3H_6

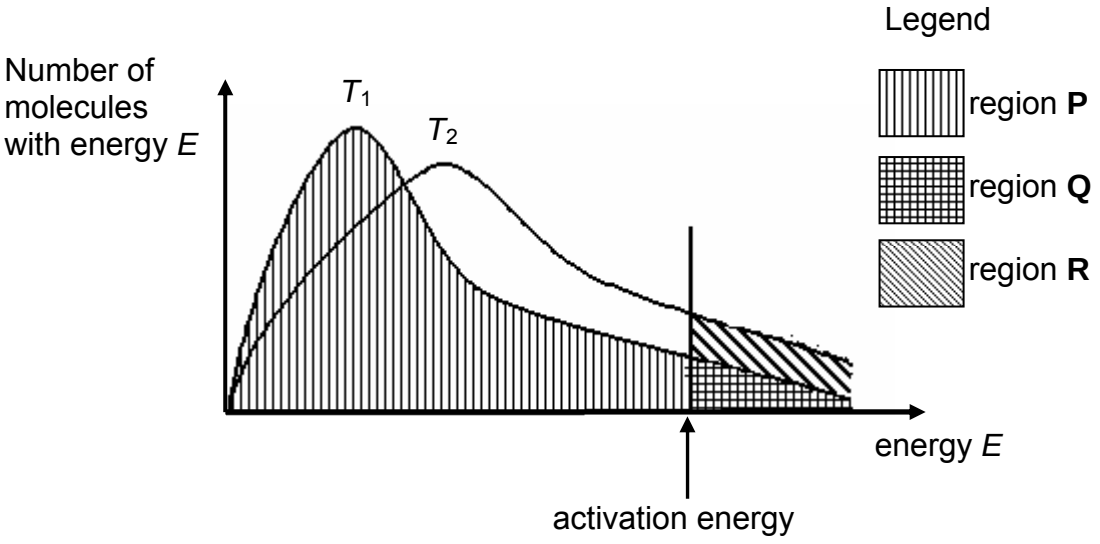
5 The enthalpy change when solid sodium hydroxide dissolves in water is -44.4 kJ mol^{-1}.

250 g of water is placed in a coffee-cup calorimeter containing 13.9 g of sodium hydroxide. If the solution has the same specific heat capacity as liquid water, what is the rise in temperature of the solution?

A $\frac{13.9\times44.4}{250\times4.18}$ K **B** $\frac{250\times4.18}{13.9\times44.4\times10^3}$ K

C $\frac{13.9\times44.4\times10^3}{40\times250\times4.18}$ K **D** $\frac{13.9\times44.4\times10^3}{263.9\times4.18}$ K

6 The distribution of the number of molecules with energy E is given in the sketch for two temperatures, T_1 and a higher temperature T_2. The letters P, Q, R refer to the separate and differently shaded areas. The activation energy is marked on the energy axis.



Which expression gives the fraction of the molecules present which have at least the activation energy at the higher temperature T_2?

A $\frac{Q}{P}$ **B** $\frac{Q+R}{P}$ **C** $\frac{Q+R}{P+Q}$ **D** $\frac{Q+R}{P+Q+R}$

7 Two equilibria are shown below.

Reaction **I**: $2NO_2(g) \rightleftharpoons 2NO(g) + O_2(g)$

Reaction **II**: $NO(g) + \frac{1}{2}O_2(g) \rightleftharpoons NO_2(g)$

The numerical value of K_c for reaction **I** is 0.36. Under the same conditions, what is the numerical value of K_c for reaction **II**?

A 0.18 **B** 1.7 **C** 2.8 **D** 5.6

8 The table shows the data on two acid-base indicators.

indicator	approximate pH range	colour change	
		in acid	in alkali
bromocresol green	3.8 – 5.5	yellow	blue
phenol red	6.8 – 8.5	yellow	red

What conclusion can be drawn about a solution in which bromocresol green is blue and phenol red is yellow?

A It is weakly acidic.

B It is strongly acidic.

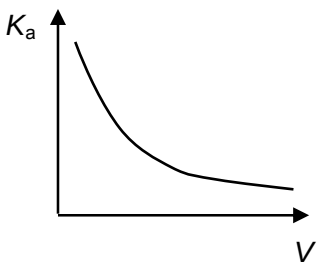
C It is neutral.

D It is weakly alkaline.

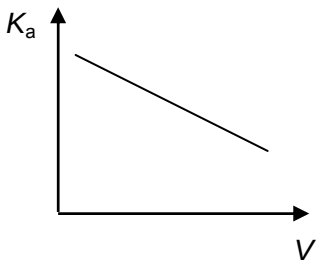
9 A sample of 1 mol of ethanoic acid is diluted at constant temperature to a volume *V*.

Which diagram shows how the acid dissociation constant, K_a, varies with *V*?

A



B



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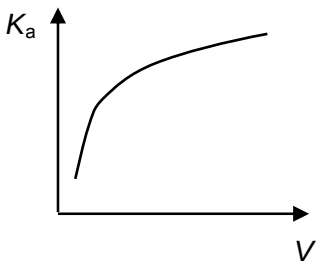
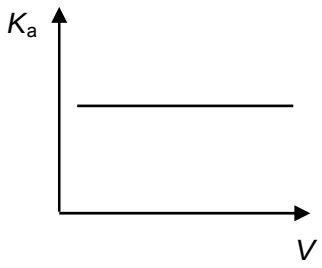


D



10 *The use of the Data Booklet is relevant to this question.*

What will be observed when a few drops of acidified aqueous hydrogen peroxide are added to an excess of aqueous potassium iodide?

A The solution turns brown and effervescence occurs.

B The solution turns brown without effervescence.

C The solution does not change colour and effervescence occurs.

D The solution turns purple and effervescence occurs.

11 When a large current was passed through acidified aqueous copper (II) sulphate, there was simultaneous liberation, at the cathode, of x mol of copper and y dm^3 of hydrogen (measured at s.t.p.).

How many moles of electrons passed through the solution?

A $x + \frac{y}{22.4}$ **B** $x + \frac{y}{11.2}$

C $2x + \frac{y}{11.2}$ **D** $2x + \frac{y}{22.4}$

12 Which of the following statements about the Group VII compounds is correct?

A The hydration energy of the gaseous halide ions becomes more negative down the group.

B The K_{sp} values of the silver halides decrease down the group.

C The lattice energy of the silver halides becomes more exothermic down the group.

D The halogens increase in oxidising power down the group.

13 In which of the following pairs is the ionic radius of the first ion smaller than that of the second ion?

A Na^+, Mg^{2+} **B** Mg^{2+}, S^{2-} **C** F^-, Na^+ **D** P^{3-}, S^{2-}

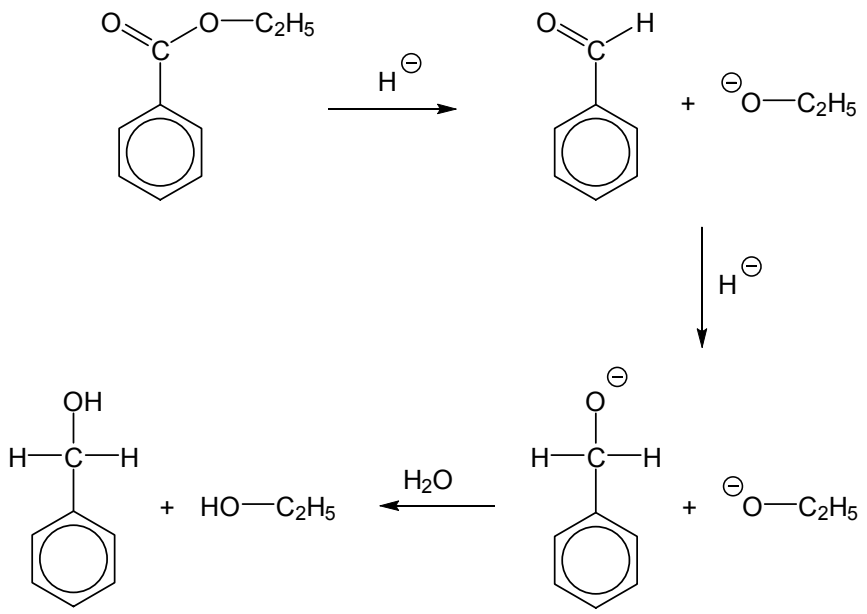
14 Iron has a proton (atomic) number of 26.

What is the electronic configuration of the iron cation which can form the complex ion $[Fe(H_2O)_5SCN]^{2+}$? [[Ar] ≡ $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$]

A [Ar] $3d^3\ 4s^2$ **B** [Ar] $3d^4\ 4s^2$

C [Ar] $3d^5\ 4s^0$ **D** [Ar] $3d^6\ 4s^0$

15 Esters can be converted to alcohols using lithium aluminium hydride followed by the addition of water.



Which of the following reaction does **not** occur in this process?

A hydrogenation

B hydrolysis

C nucleophilic addition

D nucleophilic substitution

16 In the free radical substitution of 2-methylbutane with bromine, a mixture of mono-brominated compounds were obtained.

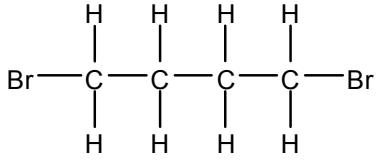
What is the statistical ratio of the two compounds with the highest yields?

A 1 : 1 **B** 1 : 2

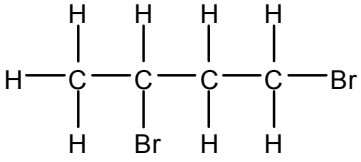
C 1 : 3 **D** 1 : 6

17 Which compound could be formed by the action of bromine on an alkene of molecular formula C_4H_8?

A



B



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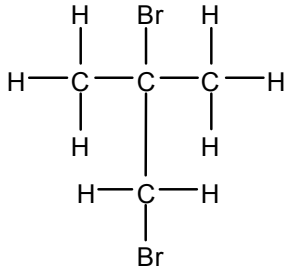
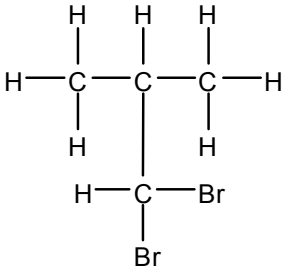


D



18 Oxidation of an alkene gives a diol; further oxidation gives a diketone.
What is the formula of the alkene?

A $(CH_3)_2C=C(CH_3)_2$

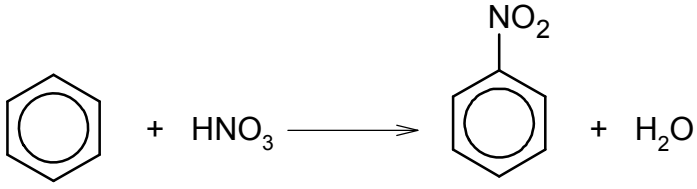
B $CH_3CH=C(CH_3)_2$

C $C_6H_5CH=CHC_6H_5$

D $(C_6H_5)_2C=CHCH_3$

19 Nitrobenzene is a yellow liquid with the smell of almonds. It may be prepared by heating a mixture of benzene, concentrated nitric acid and concentrated sulphuric acid under reflux.

Why is concentrated sulphuric acid used?



A It acts as a dehydrating agent to remove the water produced.

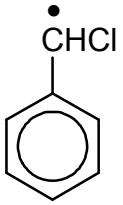
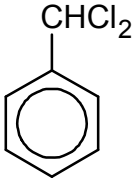
B It donates protons to nitric acid, thus forming NO_2^+ ions.

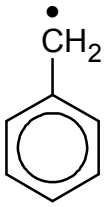
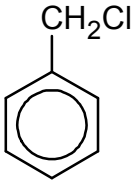
C It removes protons from nitric acid, thus forming NO_2^- ions.

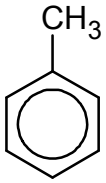
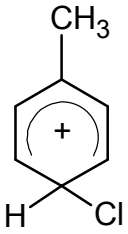
D It acts as a catalyst to speed up the reaction.

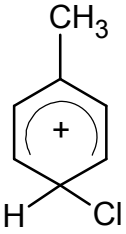
20 The reaction between boiling methylbenzene and chlorine takes place in a number of steps to give several products.

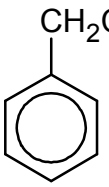
Which of the following could **not** be one of the steps?

A  + Cl_2 →  + $Cl\bullet$

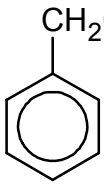
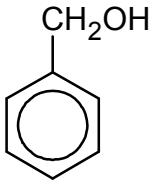
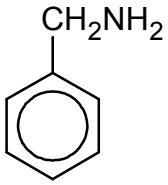
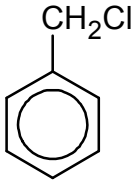
B  + HCl →  + $H\bullet$

C  + Cl^+ → 

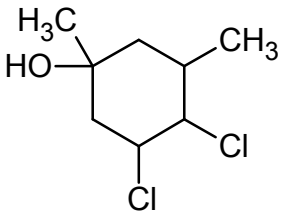
D  + $[FeCl_4]^-$ →  + HCl + $FeCl_3$

21 Compound **Y** reacts with a reagent **Z** to form  .

What could **Y** and **Z** be?

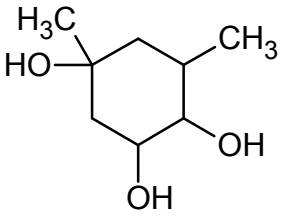
	Y	**Z**
A		NaCN in ethanol
B		NaCN(aq)
C		HCN(aq)
D		HCN(aq)

22 The following compound was heated with alcoholic potassium hydroxide.

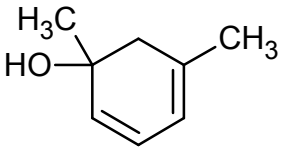


Which of the following represents the structure of the organic product?

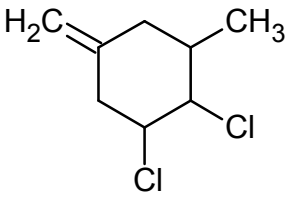
A



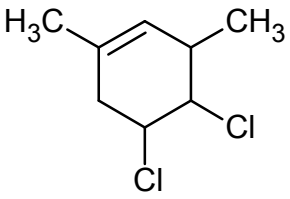
B



C



D



23 Which reaction yields a carbon compound incorporating deuterium, D? [D = ^{2}H]

A $(CH_3)_3COH \xrightarrow[\text{heat}]{\text{DBr}}$

B $CH_3CH(OH)CH_3 \xrightarrow[\text{heat}]{\text{conc } D_2SO_4}$

C $CH_3CH_2CH_2OH \xrightarrow[D_2O,\ \text{heat}]{\text{NaOD, } KMnO_4}$

D $CH_3CH(OH)CH_3 \xrightarrow[D_2O]{I_2,\ \text{NaOD}}$

24 Which of the following reagents is the best test to distinguish between phenol and methylbenzene?

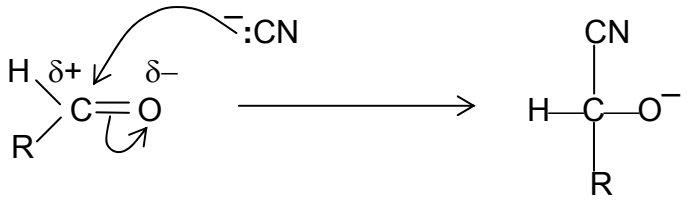
A Na

B Na_2CO_3

C Cl_2 in the presence of $FeCl_3$

D concentrated HNO_3 / concentrated H_2SO_4

25 One step of the mechanism between HCN and a carbonyl compound is shown below:



Which of the following statements is **not** correct?

A The cyanide ion is acting as a nucleophile.

B The product formed has one more carbon than the original compound.

C This reaction takes place at high temperatures.

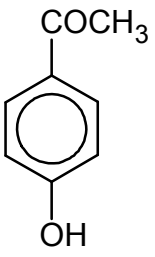
D The products formed do not rotate plane-polarised light.

26 Compound **X**

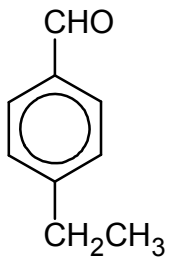
- can react with 2,4-dinitrophenylhydrazine,
- does not react with Fehling's solution,
- can be oxidized to benzene-1,4-dicarboxylic acid.

What could **X** be?

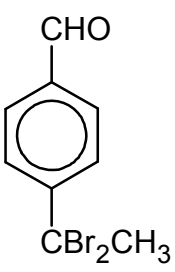
A



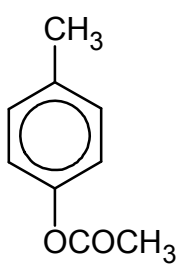
B



C



D



27 In which sequence is it correctly stated that the value of pK_a **decreases** continuously?

A $CH_3CO_2H > CCl_3CO_2H > C_6H_5OH$

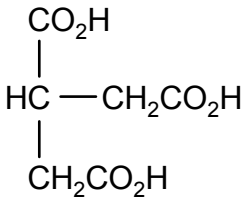
B $CCl_3CO_2H > CH_3CO_2H > C_6H_5OH$

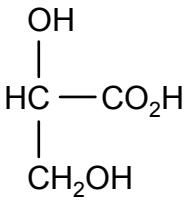
C $C_6H_5OH > CH_3CO_2H > CCl_3CO_2H$

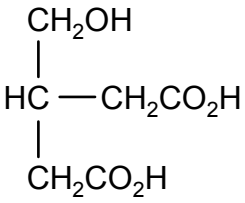
D $C_6H_5OH > CCl_3CO_2H > CH_3CO_2H$

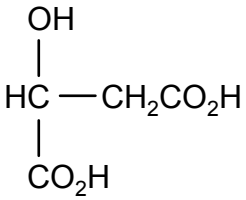
28 One industrial preparation of ethanoic acid is the direct carbonylation of methanol using a rhodium catalyst.

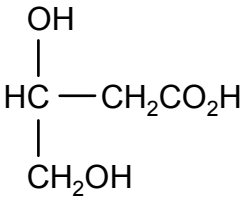
$$CH_3OH + CO \xrightarrow[\text{catalyst}]{\text{rhodium}} CH_3CO_2H$$

Which compound could be expected to produce  by this method?

A 

B 

C 

D 

29 Compound **Y**

- produces fumes of HCl with PCl_5,
- liberates NH_3 when heated with NaOH(aq)

What could **Y** be?

A $HOCH_2CH_2NH_2$

B $HOCH_2CONH_2$

C $HOCH_2CH(NH_2)CO_2H$

D $H_2NCH_2CO_2H$

30 Some aminoethanoic acid is dissolved in a buffer solution of pH = 9.0. Which of the following gives the structure of the two main forms of aminoethanoic acid at this pH?

A $H_3\overset{+}{N}CH_2CO_2H$ and $NH_2CH_2CO_2H$

B $H_3\overset{+}{N}CH_2CO_2H$ and $H_3\overset{+}{N}CH_2CO_2^-$

C $H_3\overset{+}{N}CH_2CO_2H$ and $H_2NCH_2CO_2H$

D $H_3\overset{+}{N}CH_2CO_2^-$ and $H_2NCH_2CO_2^-$

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 which 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 statements about aluminum chloride are true?

1 It exists as the dimer Al_2Cl_6 in vapour state.

2 It reacts rapidly with water.

3 It reacts with aqueous sodium hydroxide to give a white precipitate which dissolves in excess alkali.

32 A container of volume 30 dm^3 contains an ideal gas **A** at a pressure of 5 atm. Another container of volume 20 dm^3 contains an ideal gas **B** at a pressure of 15 atm. When the containers are connected at constant temperature, both gases **A** and **B** flowed freely throughout both containers.

Which of the statements best describe the gases in the combined containers?

1 The partial pressure of gas **A** is 3 atm if the gases do not react.

2 The total pressure after connection is less than 9 atm if the gases react according to the equation **A(g) + B(g)** $\rightarrow$ **C(g)**.

3 The total pressure in the containers after the connection is 20 atm if the gases do not react.

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.

33 What can be deduced from the following information?

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g);\ \Delta H = -98\ \text{kJ mol}^{-1}$$

1 Increasing the pressure increases the equilibrium yield of $SO_3(g)$.

2 The value of K_p falls with a rise in temperature.

3 Adding a suitable catalyst increases the equilibrium yield of $SO_3(g)$.

34 Which of the following statements explain why silver chloride is soluble in aqueous ammonia, but silver iodide is not?

1 The solubility product of silver chloride is numerically larger than that of silver iodide.

2 The equilibrium constant for

$Ag\mathit{X}(s) + 2NH_3(aq) \rightleftharpoons Ag(NH_3)_2\mathit{X}(aq)$

is numerically greater for X = C*l* than for X = I.

3 The lattice energy of silver chloride is numerically larger than that of silver iodide.

35 Concentrated sulphuric acid reacts differently with each of the sodium halides, NaC*l*(s), NaBr(s) and NaI(s). This is due to their differing chemical properties.

Which of the following statements about the reaction are true?

1 Redox reaction occurred with concentrated sulphuric acid only for sodium bromide and sodium iodide.

2 There is a difference in the extent of the reduction of the sulphuric acid when we compare the reactions of bromide and iodide with concentrated sulphuric acid.

3 White fumes produced in all three reactions indicates that acid-base reaction occurred for all three sodium halides.

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.

36 *The use of the Data Booklet is relevant to this question.*

The exhaust systems of most new cars are fitted with catalytic converters that contain transition metals as catalysts to decrease the emission of atmospheric pollutants. Platinum and palladium are the two most common elements used. They come below Ni in the Periodic Table.

Which properties are nickel, palladium and platinum likely to have in common?

1 variable oxidation states

2 high melting points

3 similar atomic radius

37 Chlorofluorocarbons (CFCs) have been widely used in aerosol sprays, refrigerators and in making foamed plastics, but are now known to destroy ozone in the upper atmosphere.

Which of the following will not destroy ozone, and therefore can be used safely as a replacement for CFCs?

1 $CH_3CH_2CH_2CH_3$

2 CCl_3CBr_3

3 $CHClFCClF_2$

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.

38 Thiols are organic compounds containing the −SH functional group. They are sulphur analogue of alcohols. Some common reactions undergone by thiols are shown as follows.

I $CH_3CH_2SH + CH_3CH_2Br \rightarrow (CH_3CH_2)_2S + HBr$

II $CH_3CH_2SH + NaOH \rightarrow CH_3CH_2S^-Na^+ + H_2O$

III $2CH_3CH_2SH + Br_2 \rightarrow CH_3CH_2{-}S{-}S{-}CH_2CH_3 + 2HBr$

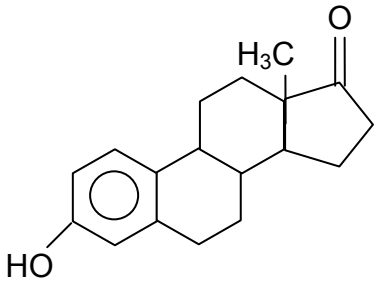
Which of the following statements comparing thiols with alcohols are true?

1 Thiols are stronger nucleophiles than alcohols.

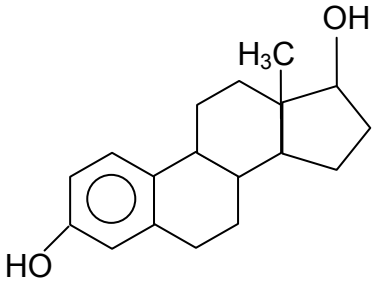
2 Thiols are stronger acids than alcohols.

3 Thiols are stronger reducing agents than alcohols.

39 Two female sex hormones are oestrone and oestradiol.



oestrone



oestradiol

Which of the following reagents could be used to distinguish between the two hormones?

1 I_2 in NaOH(aq)

2 acidified $KMnO_4$

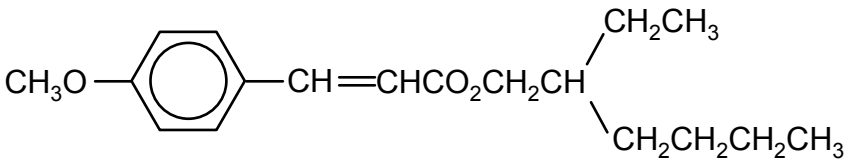
3 2,4-dinitrophenylhydrazine

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.

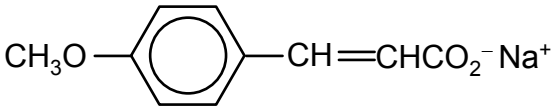
40 A sun protection cream contains the following ester as its active ingredient.



What are the products of its partial or total hydrolysis by aqueous sodium hydroxide?

1 $CH_3CH_2CH_2CH_2CH(CH_2CH_3)CH_2OH$

2



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