ANDERSON JUNIOR COLLEGE

Preliminary Examination 2008

CHEMISTRY **9746/01**
Higher 2 **15 Sep 2008**
Paper 1 Multiple Choice **1 hour**

Additional Materials: Multiple Choice Optical Answer Sheet
Data Booklet

READ THESE INSTRUCTIONS FIRST

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 Optical 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.

Optical Answer Sheet

Write your name and PDG.
Shade the last 5 digits of your NRIC / FIN number. DO NOT shade the reference letter.

This document consists of **14** 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 To determine the mass of arsenic present in a sample of pesticide, all the arsenic was first converted to arsenate ion, AsO_4^{3-}. 1.25×10^{-3} moles of $AgNO_3$ was then added to precipitate AsO_4^{3-} as Ag_3AsO_4. The excess Ag^+ ions needed 3.64 cm^3 of 0.054 mol dm^{-3} KSCN to form silver thiocyanate, AgSCN.

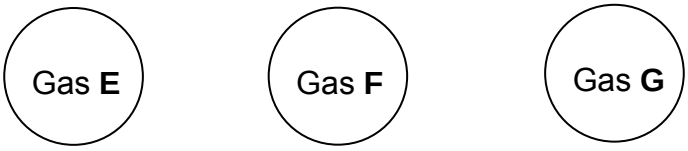
Calculate the mass of arsenic (A_r = 74.9) present in the sample of pesticide.

A 0.015 g **B** 0.026 g **C** 0.079 g **D** 0.488 g

2 An aqueous solution contains 1 mole of $S_2O_3^{2-}$ ions and this reduces 4 moles of Cl_2 molecules. What is the sulphur-containing product of this reaction?

A SO_2 **B** SO_3^{2-} **C** SO_4^{2-} **D** $S_4O_6^{2-}$

3 Three identical flasks each contains the same mass of gases **E**, **F** and **G** respectively. The temperature and pressure of each flask are indicated below.



	Gas **E**	Gas **F**	Gas **G**
Temperature / ^oC	***t***	***t***	***2t***
Pressure / atm	***p***	***2p***	***p***

Assuming ideal gas behaviour, which of the following is a correct representation of the relative molecular masses of the three gases?

A M_r(**G**) > M_r(**E**) > M_r(**F**)
B M_r(**G**) > M_r(**F**) > M_r(**E**)
C M_r(**E**) > M_r(**F**) > M_r(**G**)
D M_r(**E**) > M_r(**G**) > M_r(**F**)

4 The ion $\mathbf{X}^{2+}$ has 54 electrons and 81 neutrons.

Which of the following statements is true?

A Element **X** is isoelectronic with xenon.
B The first ionization energy of element **X** is higher than that of Mg.
C The oxide of **X** formed is expected to have a higher melting point than MgO.
D In an electric field, the ion $\mathbf{X}^{2+}$ will be deflected at a smaller angle than that of Mg^{2+}.

5 Which of the following statements **cannot** be explained by hydrogen bonding?

A Ice has a density lower than water at 0 ^oC.
B The boiling point of 2-nitrophenol is lower than that of 4-nitrophenol.
C The boiling point of ethanal is higher than dimethyl ether, CH_3OCH_3.
D The relative molecular mass of ethanoic acid is 120 when dissolved in benzene.

6 Which of the following pairs of substances **does not** include a giant structure and a simple molecular structure?

A aluminum and silicon(IV) oxide
B aluminium oxide and aluminium chloride
C silicon and chlorine
D silicon and silicon(IV) chloride

7 Given the following enthalpy changes

$CH_3CH_3 \longrightarrow CH_3CH_2\bullet + H\bullet \qquad \Delta H = +412 \text{ kJ mol}^{-1}$
$CH_3CH_2\bullet \longrightarrow CH_2{=}CH_2 + H\bullet \qquad \Delta H = +168 \text{ kJ mol}^{-1}$

What is the enthalpy change of the following reaction?

$2\ CH_3CH_2\bullet \longrightarrow CH_3CH_3 + CH_2{=}CH_2$

A +412 kJ mol^{-1} **B** +244 kJ mol^{-1} **C** –244 kJ mol^{-1} **D** –412 kJ mol^{-1}

8 A simple rechargeable battery is constructed by dipping two lead electrodes into aqueous lead(II) nitrate and passing current through it for a few minutes. When it is fully charged, lead(IV) oxide is deposited on one of the electrodes. During normal usage, a voltage of +1.60V is produced and the following reactions occur:

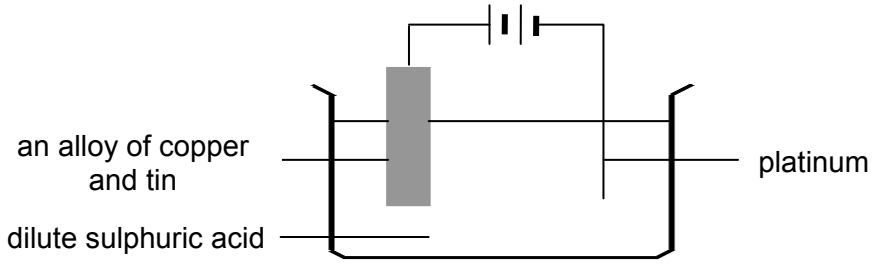
Anode: $Pb \longrightarrow Pb^{2+} + 2e$

Cathode: $PbO_2 + 4H^+ + 2e \longrightarrow Pb^{2+} + 2H_2O$

Which of the following changes can be made to the cell to increase the e.m.f.?

A Increasing the size of the lead electrodes
B Using a higher current during charging of the battery
C Using a higher concentration of lead(II) nitrate
D Replacing the electrolyte with dilute sulphuric acid

9 The circuit shown in the diagram was set up.



Which reactions will occur at the electrodes?

	anode reaction	*cathode reaction*
A	Oxygen gas is evolved.	Hydrogen gas is evolved.
B	Tin dissolves preferentially.	Hydrogen gas is evolved.
C	Copper dissolves preferentially.	Copper is deposited.
D	Copper and tin both dissolve.	Sulphur dioxide gas is evolved.

10 The following reaction is used industrially to produce a combustible gas from coal.

$$H_2O(g) + C(s) \rightleftharpoons H_2(g) + CO(g)$$

At equilibrium, the partial pressure of each gaseous species is **p** atm at 500^{o}C. When the total pressure of the system was increased at the same temperature, the partial pressure of the $H_2O(g)$ increased to 4**p** atm at the new equilibrium.

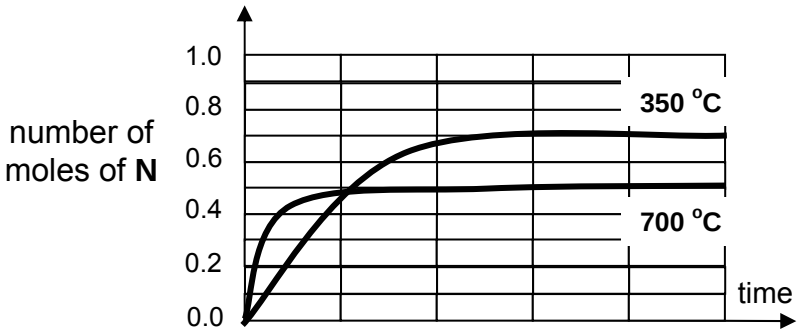
What would be the partial pressure of CO(g) at the new equilibrium?

A 0.5**p** atm
B **p** atm
C 2**p** atm
D 4**p** atm

11 **J** and **L** can react together to reach equilibrium in the reaction below.

$$\mathbf{J}(g) + \mathbf{L}(g) \rightleftharpoons \mathbf{M}(g) + \mathbf{N}(g)$$

In an experiment, 1.0 mole each of **J** and **L** were reacted at constant pressure P and temperature 350 ^{o}C. The amount of **N** present in the mixture was recorded at regular intervals of time. The experiment was repeated at the same pressure P, but at a temperature of 700 ^{o}C. The results for both experiments are shown below.



Which of the following information **cannot** be deduced from the graph?

A The activation energy of the forward reaction is high.
B The forward reaction is exothermic.
C The value of K_p at 350 ^{o}C is 5.44.
D The time taken for the equilibrium to be achieved is shorter at higher temperatures.

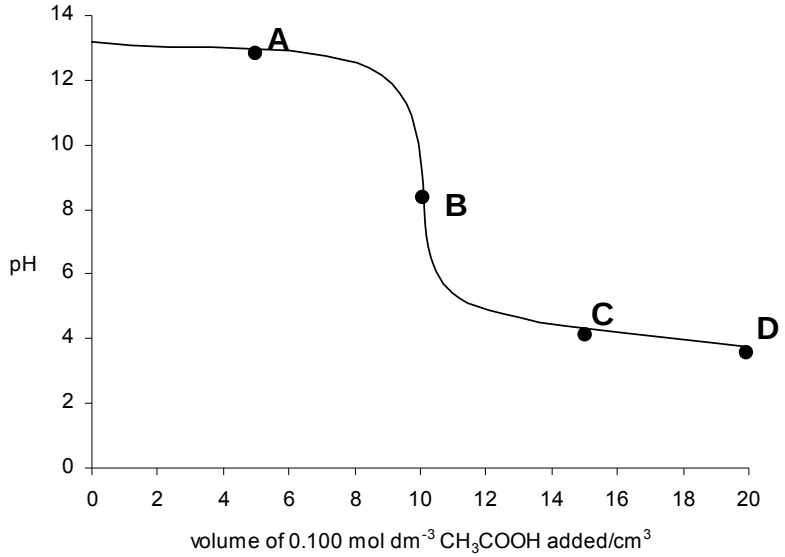
12 A solution, saturated with $Ca(OH)_2$ and $CaSO_4$, has a pH of 12.3. What is the concentration, in mol dm^{-3}, of SO_4^{2-} ions in the solution?

(K_{sp} value of $Ca(OH)_2$ = 4.0 x 10^{-5}, K_{sp} value of $CaSO_4$ = 2.5 x 10^{-5})

A 1.25 x 10^{-4}
B 2.50 x 10^{-4}
C 1.25 x 10^{2}
D 2.50 x 10^{2}

13 The pH change when 0.100 mol dm^{-3} CH_3COOH is added dropwise to 10.0 cm^3 of 0.100 mol dm^{-3} NaOH(aq) is shown below.

At which point on the graph does pH = pK_a, where K_a is the acid dissociation constant of the weak acid?

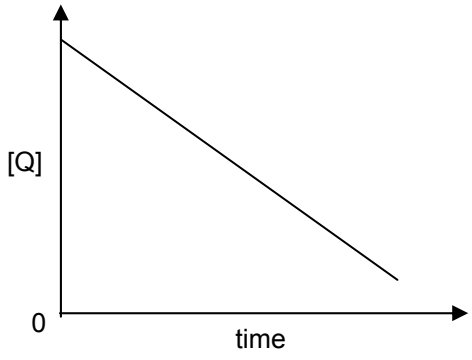


14 For the reaction **P** + 2**Q** → **R** + **S**, the rate equation is found experimentally to be:

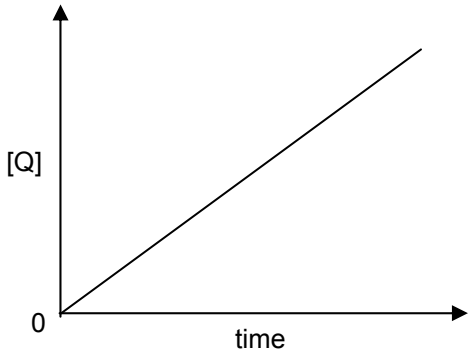
rate = k[**P**]

If the reaction is carried out using excess **P**, which of the following graphs most correctly represents the change in concentration of **Q** with time?

A



B



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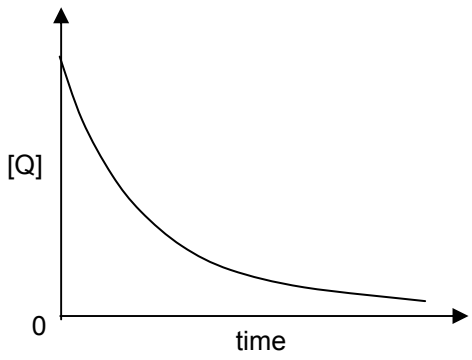

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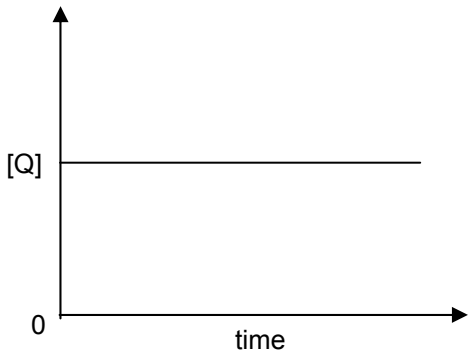


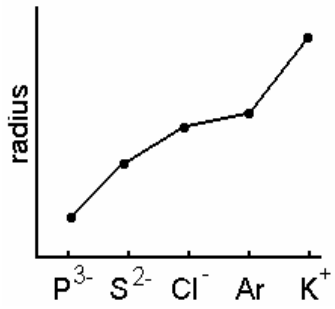
15 Beryllium resembles aluminium in its chemical properties.

Which property of beryllium compounds is **unlikely** to be correct?

A Beryllium oxide can undergo reaction with acids.
B Beryllium oxide can undergo reaction with alkali.
C Beryllium chloride can form a dimer.
D Beryllium chloride is an ionic compound.

16 Which graph correctly shows the variation of the radii of the species shown?

A



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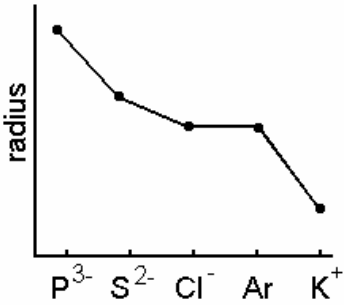

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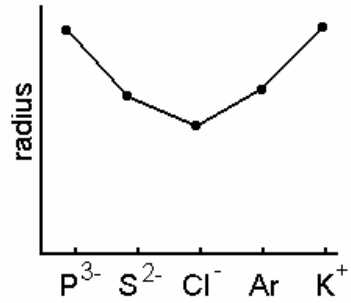

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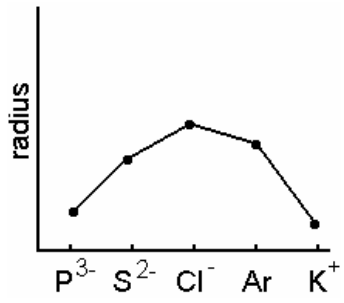
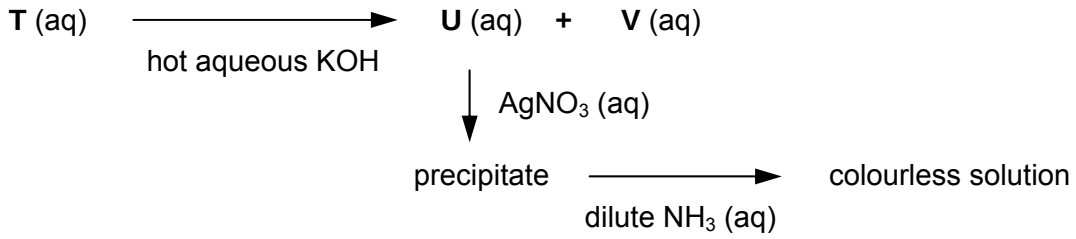


17 Magnesium oxide is insoluble in water whereas barium oxide dissolves to give an alkaline solution.

Which factor accounts for the difference in the behaviour of magnesium oxide and barium oxide in water?

A The magnitude of the lattice energy of magnesium oxide is larger than that of barium oxide.
B The first and second ionisation energies of magnesium are larger than that of barium.
C Magnesium is less electropositive than barium.
D The enthalpy change of hydration of magnesium ion is less exothermic than that of barium ion.

18 Consider the following reaction route.



What could solutions **T**, **U** and **V** be?

	T	**U**	**V**
A	Cl_2	KC*l*	KC*l*O
B	Cl_2	KC*l*	KC*l*O_3
C	I_2	KI	KIO
D	I_2	KI	KIO_3

19 Letters written on paper using aqueous ammonium thiocyanate are invisible until turned blood–red by brushing the paper with aqueous iron(III) chloride. If the ammonium thiocyanate is first made alkaline, the letters are orange and less clear.

Which of the following substances, when formed on the paper in these reactions, best explains these observations?

	with aqueous ammonium thiocyanate	*with alkaline aqueous ammonium thiocyanate*
A	$[Fe(SCN)(H_2O)_5]^{2+}$	$[Fe(SCN)(OH)(H_2O)_4]^{+}$
B	$[Fe(SCN)(H_2O)_5]^{2+}$	$Fe(OH)_3$
C	$[Fe(SCN)(NH_3)_5]^{2+}$	$Fe(OH)_3$
D	$[Fe(SCN)(NH_3)_5]^{2+}$	$[Fe(NH_3)_6]^{3+}$

20 How many alkenes (both structural isomers and stereoisomers) can be obtained from the molecular formula C_5H_{10}?

A 4 **B** 5 **C** 6 **D** 7

21 Chlorofluorocarbons (CFCs) are commonly used as aerosols, propellants and refrigerants. However in the stratosphere, CFCs can damage the ozone layer through a radical chain reaction.

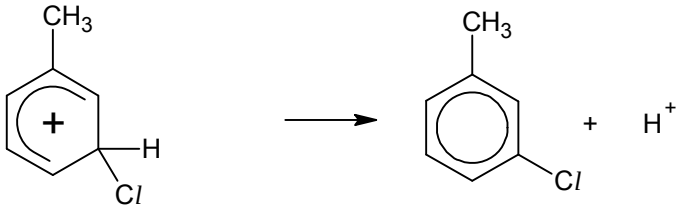
In which sequence are the following compounds listed in increasing order of their ability to destroy ozone?

A	CHC*l*FCC*l*F_2	<	CCl_2FCCl_2F	<	CHC*l*F_2
B	CCl_2FCCl_2F	<	CHC*l*F_2	<	CHC*l*FCC*l*F_2
C	CHC*l*F_2	<	CCl_2FCCl_2F	<	CHC*l*FCC*l*F_2
D	CHC*l*F_2	<	CHC*l*FCC*l*F_2	<	CCl_2FCCl_2F

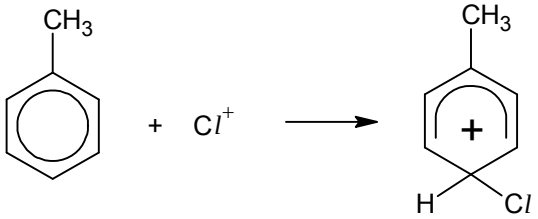
22 The reaction between boiling methylbenzene and chlorine takes place in a number of steps to give several products.

Which of the following could be one of the steps?

A



B



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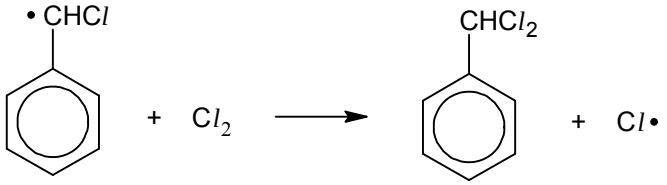

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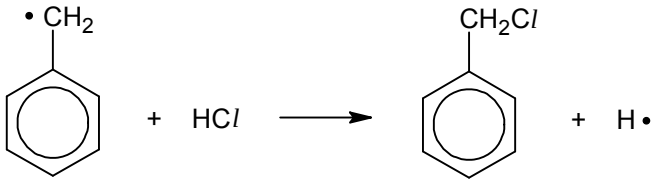
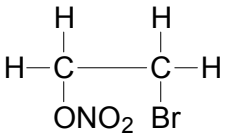
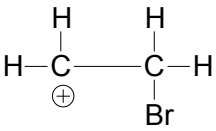


23 When ethene reacts with bromine in the presence of concentrated aqueous sodium nitrate, the product contains the following compound.



What is the intermediate formed in this reaction?

A



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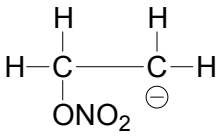

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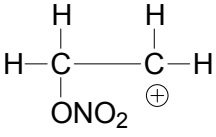

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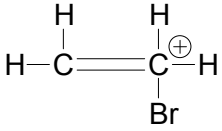
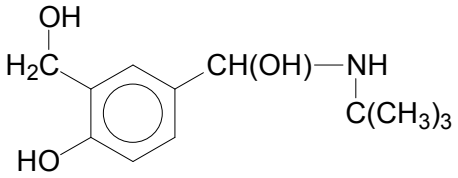


24 A halogen compound, **W**, is heated in a sealed tube with ammonia while a nitrile, **X**, is reacted with lithium aluminium hydride in dry ether.

Which of the following pairs of **W** and **X** give the same product?

	W	**X**
A	$BrCH_2CO_2H$	HO_2CCH_2CN
B	$CH_3OCH_2CH_2F$	CH_3OCH_2CN
C	$(CH_3)_2CHCl$	$(CH_3)_2CHCN$
D	$C_6H_5CHICH_2CH_3$	$C_6H_5CH(CN)CH_2CH_3$

25 Salbutamol is used as a temporary relief of bronchospasm in asthmatic patients.



Salbutamol

Which deduction about salbutamol can be made from this structure?

A 1 mole of salbutamol reacts with 4 moles of dilute HNO_3.
B The product of oxidation with acidified potassium manganate(VII) gives a red brown precipitate with Fehlings' solution.
C It undergoes dehydration with hot Al_2O_3 to form an alkene.
D It turns reddish brown bromine solution colourless.

26 A compound **Y**, $C_8H_{10}O$, gives compound **Z**, C_8H_8O, on oxidation. Both **Y** and **Z** give a yellow precipitate on warming with aqueous alkaline iodine.

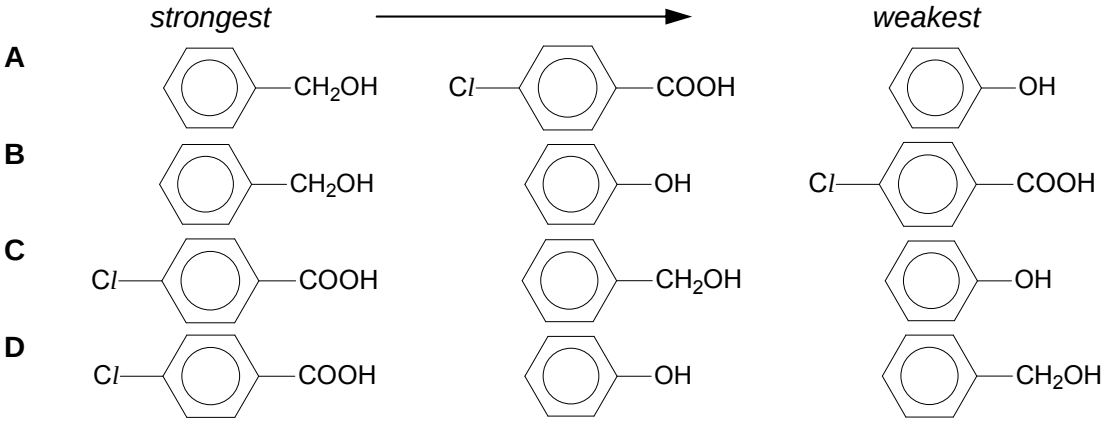
Which of the following could be **Y**?

A 2,4-dimethylphenol
B 3-ethylphenol
C 1-phenylethanol
D 2-phenylethanol

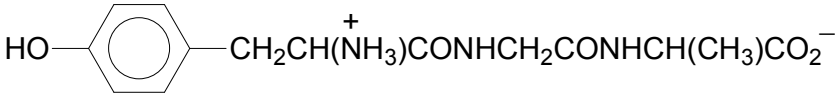
27 Why does hydrogen cyanide add to propanone but not to propene?

A Propanone is more susceptible to CN^- attack than propene.
B The addition product formed with propene would not be stable.
C Propanone is more susceptible to H^+ attack than propene.
D The two methyl groups in propanone exert a stronger electron-donating effect than the single methyl group in propene.

28 Which sequence shows the organic compounds in **decreasing** order of acid strength?



29 The structure of a tripeptide, tyrosylglycylalanine, is shown below.

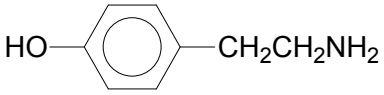


Which compound could be obtained when the tripeptide reacts with hot dilute NaOH?

A $NH_2CH_2CO_2H$

B $^-O_2CNHCH_2CO_2^-$

C



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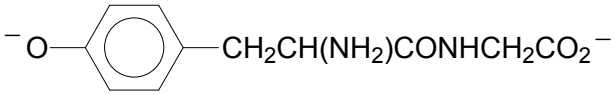
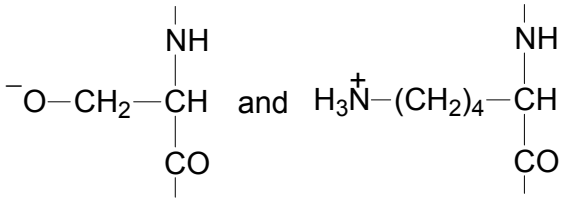
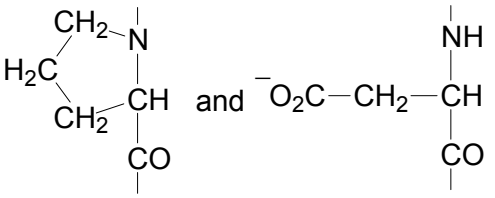


30 Which pair of amino-acid residue has an interaction which is likely to be broken during denaturation of protein due to a change in pH?

A



B



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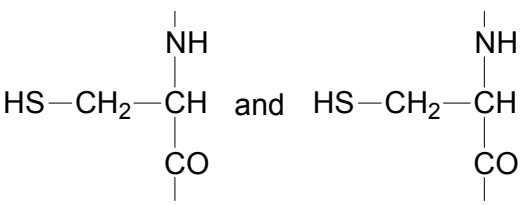

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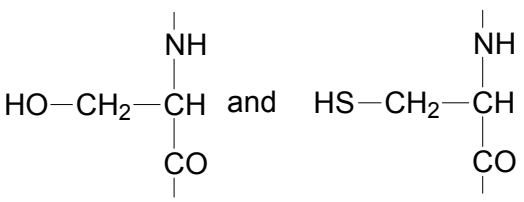


Section B

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 these 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 For which of the following pairs does species **I** have a smaller bond angle than species **II**?

	I	**II**
1	NO_2^-	NO_2^+
2	H_2S	SO_2
3	PH_4^+	ICl_4^-

32 The radius and charge of six ions are given below.

Ion	J^+	L^+	M^{2+}	X^-	Y^-	Z^{2-}
Radius / nm	0.14	0.18	0.15	0.14	0.18	0.15

The ionic solids **MZ**, **JX** and **LY** are of the same lattice type.

Which of the following statements are correct?

1 The melting point of **JX** is higher than that of **LY**.
2 The numerical value of the lattice energy of **MZ** is greater than that of **JX**.
3 The numerical value of the hydration energy of J^+ is smaller than that of M^{2+}.

33 The value of the ionic product of water, K_w, varies with temperature.

temperature / °C	K_w / $mol^2\ dm^{-6}$
25	1.00×10^{-14}
62	1.00×10^{-13}

Which of the following statements are correct?

1 The concentration of $H^+(aq)$ is greater than the concentration of $OH^-(aq)$ at 62 °C.
2 The pH of pure water at 62 °C is smaller than 7.
3 The ionic dissociation of water is an endothermic process.

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.

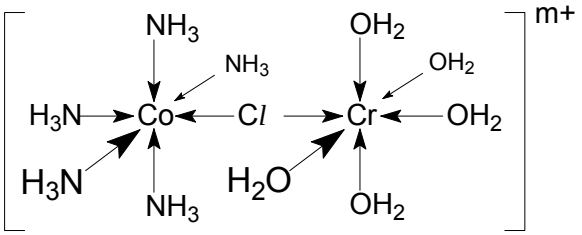
34 The activation energy of a reaction is usually

1 different for the forward and reverse reactions in an endothermic process.
2 high for a reaction that takes place slowly.
3 unaffected by a change in temperature.

35 Which statements concerning the element astatine (proton number 85) are consistent with its position in Group VII?

1 The element is a solid at room temperature and pressure.
2 Hydrogen astatide is more acidic than hydrogen chloride.
3 Astatine and aqueous potassium chloride react to form aqueous potassium astatide and chlorine.

36 The Cl^- in $[CoCl(NH_3)_5]^{2+}$ acts as a good bridging ligand to $[Cr(H_2O)_6]^{2+}$ to produce a bridged complex intermediate as shown below.



Which of the following deduction can be made from the structure of this complex intermediate?

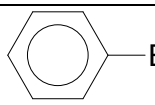
1 The chromium ion has been reduced.
2 The complex intermediate is an ion with a charge of 4+.
3 Cl^- is a good bridging ligand since it contains more than one lone pair of electrons.

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.

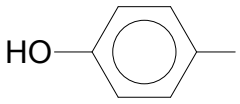
37 Three halogen compounds **P**, **Q** and **R** were heated separately with aqueous sodium hydroxide followed by the addition of aqueous silver nitrate to the resultant mixture. The following observations were recorded.

	Compound	*Observations*
P	CH_3CH_2Cl	white precipitate
Q	CH_3CH_2I	yellow precipitate
R		no precipitate

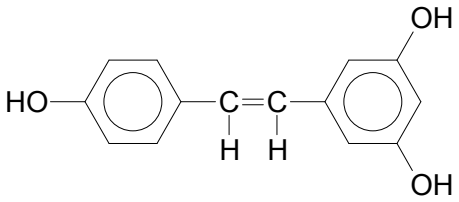
Which of the following statements are correct?

1 The reaction of NaOH(aq) with **P** and **Q** is an example of nucleophilic substitution.

2 The yellow precipitate takes a longer time to appear than the white precipitate.

3 **R** gives  after reacting with NaOH(aq).

38 Reversatrol is an insect repellent which is emitted by damaged plants.



Which statements about reversatrol are correct?

1 Its aqueous solution is acidic.

2 It exists as a pair of stereoisomers.

3 It reacts with 3 moles of ethanol in the presence of concentrated sulphuric acid to give an ester.

39 Which reaction yields a carbon compound containing deuterium, D? [D = ^2H]

1 $CH_3COCH_3 \xrightarrow{LiAlD_4}$

2 $CH_3COCI_3 \xrightarrow[D_2O]{NaOD}$

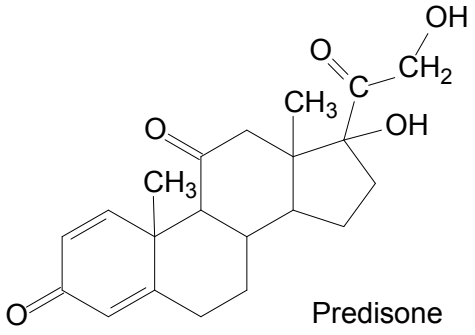
3 $CH_3CD(OD)CO_2H \xrightarrow[heat]{\text{acidified } KMnO_4}$

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 Prednisone is a steroid used to reduce unwanted swelling by decreasing the body's ability to fight infections.



Predisone

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

1 A yellow precipitate is formed on warming with aqueous, alkaline iodine.

2 2 moles of H_2O molecules are obtained on heating with excess concentrated sulphuric acid.

3 Prednisone forms an orange precipitate with 2,4-dinitrophenylhydrazine.