TEMASEK JUNIOR COLLEGE

2024 JC2 PRELIMINARY EXAMINATION

Higher 2

CHEMISTRY **9729/01**

Paper 1 Multiple Choice **12 September 2024**

1 hour

Additional Materials: Multiple Choice Answer Sheet (OMS)
Data Booklet

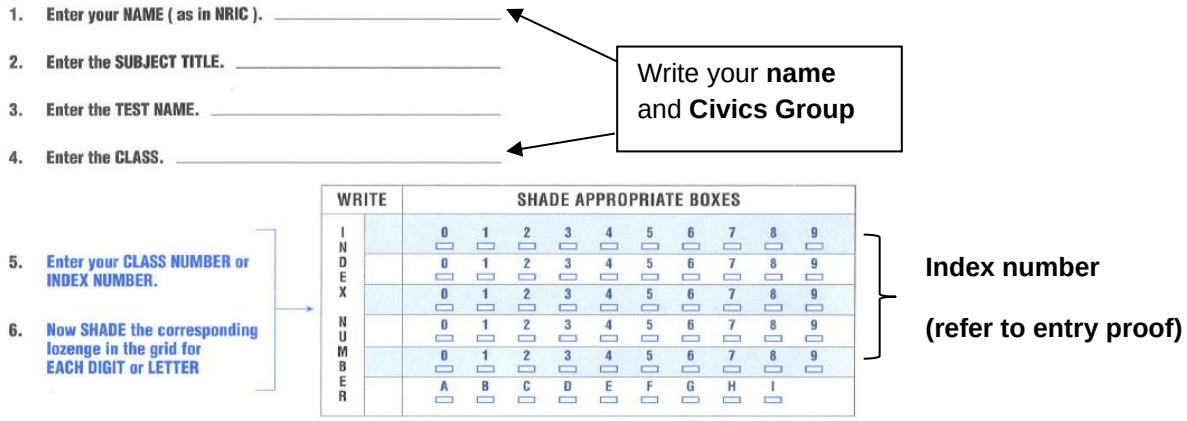
READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.

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

Write your name & Civics Group on the Answer sheet. Shade your index number in the appropriate boxes.



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

Any rough working should be done in this booklet.

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

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 (OMS).

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

Chlorine radicals is one of the main chemical species responsible for the depletion of ozone from the stratosphere.

What does $^{35}Cl^{\bullet}$ contain?

	protons	neutrons	electrons
A	18	35	17
B	18	35	18
C	17	18	17
D	17	18	18

2 Which compound is composed of cation and anion that has the same number of electrons as each other?

1 K_2O_2 **2** NaN_3 **3** NH_4F **4** K_2CO_3

A 1 and 3

B 1 and 4

C 2 and 3

D 2 and 4

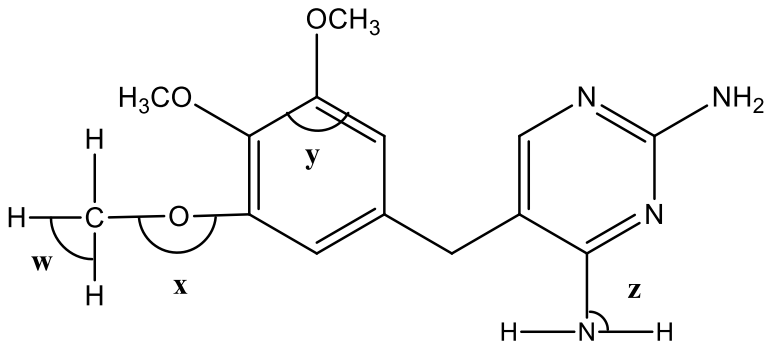
3 *Use of the Data Booklet is relevant to this question.*

The **sixth** ionisation energies of four different elements are shown below. The elements are arsenic, selenium, antimony and tellurium (though not necessarily in that order) from Groups 15 and 16.

Which of the following shows the sixth ionisation energy of antimony?

A 12300 **B** 10400 **C** 7880 **D** 6820

4 Trimethoprim (TMP) is used for the treatment of urinary tract infections. It has the following structure:



Which are the correct bond angles **w**, **x**, **y** and **z**?

	w	**x**	**y**	**z**
A	90°	180°	120°	90°
B	90°	105°	118°	107°
C	109.5°	105°	120°	107°
D	109.5°	180°	118°	120°

5 Beryllium chloride, $BeCl_2$, reacts with methylamine, CH_3NH_2 to form a compound. Which 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 beryllium atom in beryllium chloride is electron deficient.

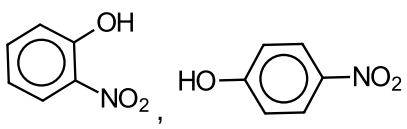
D The compound is capable of forming only two hydrogen bonds per molecule.

6 In which of the following pairs of compounds would the first compound have a higher melting point than the second compound?

A K_2O, Na_2O

B $AlCl_3$, AlF_3

C $NH_2CH_2CO_2H$, $HOCH_2CO_2H$

D 

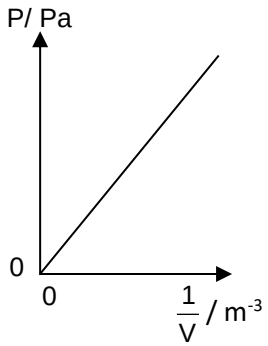
7 *Use of the Data Booklet is relevant to this question.*

A solution containing 25 cm^3 of 0.1 mol dm^{-3} VO_2^+ reacts completely with 0.245 g of zinc. Which of the following can be the vanadium-containing species in the product?

A VO_3^- **B** VO^{2+} **C** V^{3+} **D** V^{2+}

8 Which graph is a correct representation of Charles' Law?

A



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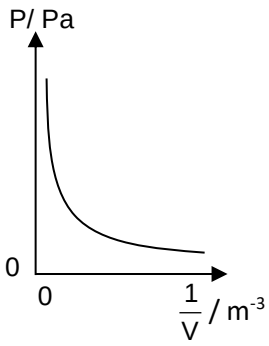

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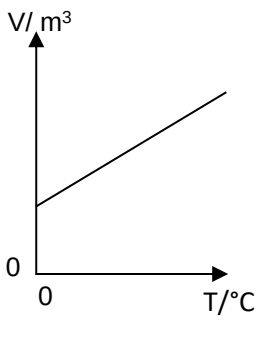

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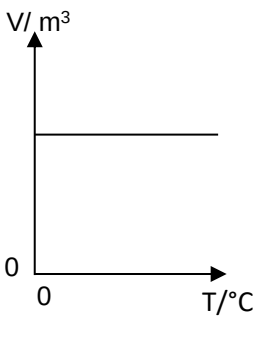


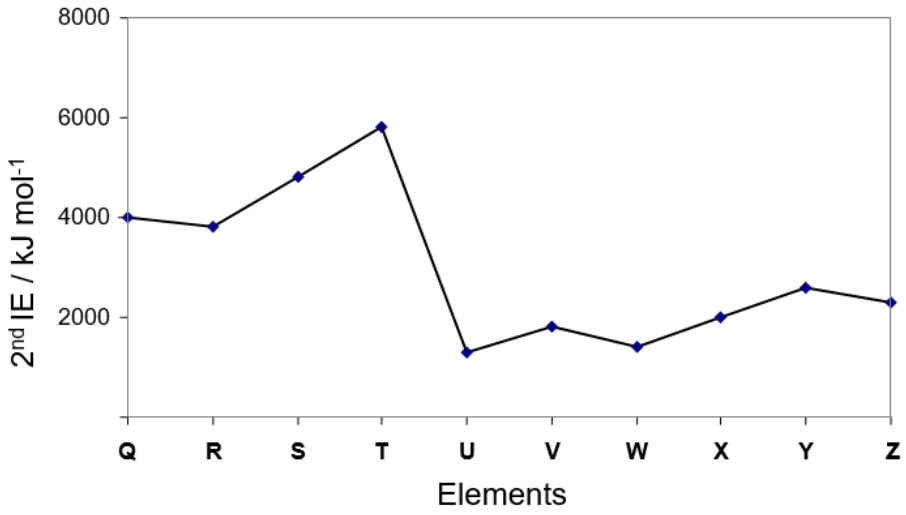
9 The three minerals below are obtained from mines around the world. Each one behaves as a mixture of two carbonate compounds. They can be used as fire retardants because they decompose in the heat, producing CO_2. This gas smothers the fire.

Barytocite	$BaCa(CO_3)_2$
Dolomite	$CaMg(CO_3)_2$
Huntite	$Mg_3Ca(CO_3)_4$

What is the order of effectiveness as fire retardant, from best to worst?

	best → worst		
A	huntite	dolomite	barytocite
B	huntite	barytocite	dolomite
C	dolomite	huntite	barytocite
D	dolomite	barytocite	huntite

10 The graph below shows the variation in the **second** ionisation energies for the consecutive elements **Q** to **Z** in the Periodic Table, all with proton number below 20.



What can be deduced from the above?

1 **T** has a smaller atomic radius than **U**.

2 Effervescence is observed when a magnesium strip is dipped into the aqueous solution containing the chloride of element **W**.

3 When the oxide of **U** is mixed with water, an alkaline solution is formed.

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

11 Which sample contains the same number of the named species as the number of molecules in 1 g of hydrogen?

A Atoms in 23.0 g of sodium

B Electrons in 1 g of helium

C Ions in 26.5 g of sodium carbonate

D Molecules in 44 g of carbon dioxide

12 When 25 cm^3 of 1.0 mol dm^{-3} sodium hydroxide was neutralised with an equal volume of 0.5 mol dm^{-3} sulfuric acid, the temperature of the mixture rose by 7.0°C.

What would be the temperature change if 50 cm^3 of 0.5 mol dm^{-3} sodium hydroxide is neutralised with an equal volume of 0.25 mol dm^{-3} sulfuric acid?

(Assume negligibe heat loss in each case.)

A 1.8°C **B** 3.5°C **C** 7.0°C **D** 14°C

13 After the closure of a chemical plant in Switzerland, a substitution reaction between a halogenoalkane, **R**, and hydrogen sulfide ions is found to take place.

initial concentration of **R** / mol dm^{-3}	initial concentration of hydrogen sulfide ions / mol dm^{-3}	initial rate of reaction / mol dm^{-3} s^{-1}
0.1	0.1	1.5×10^{-5}
0.2	0.1	3.0×10^{-5}
0.1	0.2	3.0×10^{-5}
0.3	x	1.125×10^{-5}

What conclusions can be drawn about the reaction?

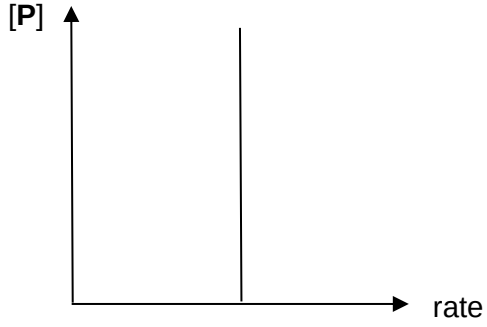
A The value of x is 0.025.

B **R** could be 2-bromo-2-methylpropane.

C The value of the rate constant is 1.5×10^{-4}.

D Only **R** is involved in the rate determining step.

14 The kinetics of a reaction **P** → **Q** were investigated under different conditions. The following graph was obtained.



Which of the following statements about the reaction is correct?

A The unit of the rate constant is s^{-1}.

B A curve is obtained when [**P**] is plotted against time.

C The same graph is obtained when the [**P**] is plotted against rate constant.

D The rate constant remained unchanged when reaction is repeated at a higher temperature.

15 $$\mathbf{A}(g) + 3\mathbf{B}(g) \rightleftharpoons 2\mathbf{C}(g)$$

A 2 dm^3 vessel containing 2.00 mol of **A**, 6.00 mol of **B**, and 2.40 mol of **C** is allowed to reach equilibrium. It was found that there was 2.32 mol of **A** was present at equilibrium.

The reaction was repeated using a 4 dm^3 vessel. The equilibrium amount of **A** was found to be y mol.

What of the following statements about the above reaction is correct?

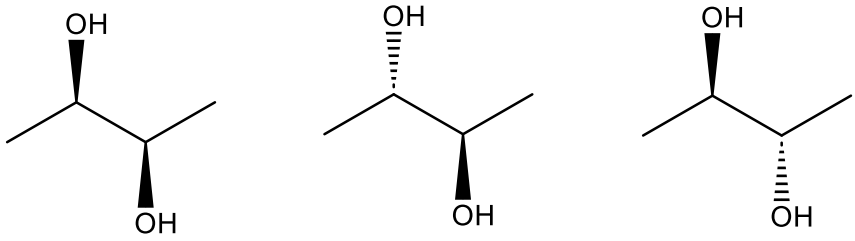
A The concentration of **C** at equilibrium is 1.76 mol dm^{-3} in the first experiment.

B The value of K_c of the second experiment is smaller than the first experiment.

C The unit of the equilibrium constant is $mol^2\ dm^{-6}$.

D y is larger than 2.32 mol.

16 Which of the following statements is correct about the 3 molecules below?



1 **2** **3**

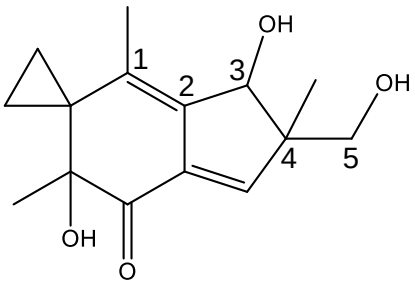
A All three molecules are constitutional isomers.

B There is a plane of symmetry in molecule 1.

C All three molecules are optically active.

D Only molecule 1 is optically active.

17 Compound **S** has strong anti-tumour and antiviral activities.



Which of the following statements of compound **S** is correct?

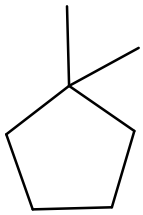
A There are four chiral centers.

B There are a total of 8 stereoisomers.

C The bond length between C1-C2 is the same as C4-C5.

D After reacting with lithium aluminium hydride in dry ether, all the carbon atoms are sp^3 hybridised.

18 In the presence of UV light, compound **W** reacts with bromine to give a mixture of products.



Compound **W**

Which of the following about the reaction is correct?

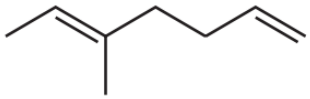
A There are three isomeric monobrominated products formed in the ratio of 2 : 2 : 3.

B The monobrominated product, $C_7H_{13}Br$, is only formed in the propagation step.

C Other products that can be formed are H_2, HBr and $C_{14}H_{26}$.

D The reaction requires a continuous supply of UV light.

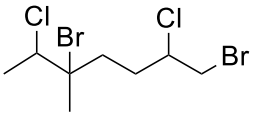
19 The structure of compound **X** is shown.



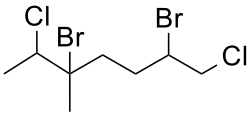
compound **X**

What is the structure of the major product when **X** reacts with BrC*l* dissolved in tetrachloromethane?

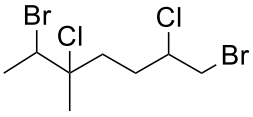
A



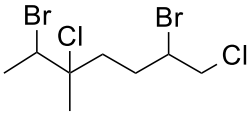
B



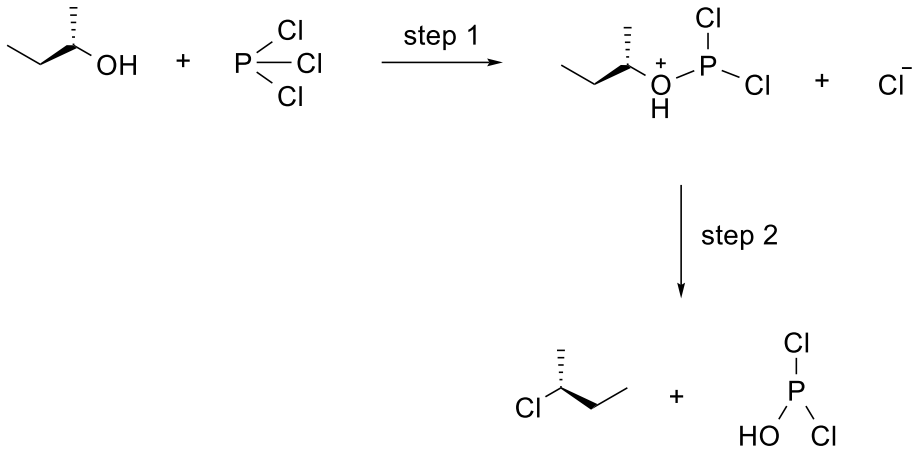
C



D



20 Chloroalkanes can be prepared by reacting an alcohol with phosphorus trichloride, PCl_3. The reaction takes place via a two-step reaction shown below.



Which of the following statements is correct?

A PCl_3 acts as a nucleophile in step 1.

B Water can be used as a solvent in this reaction.

C Step 2 follows a S_N1 mechanism.

D The transition state in step 2 is trigonal bipyramidal about a carbon atom.

21 Which of the following compounds produce **both** ethanoate ions and triiodomethane when heated with alkaline aqueous iodine?

1 $CH_3COOCH_2CH_3$

2 $CH_3CH(OH)CHI_2$

3 $CH_3CH_2CH(OH)CH_3$

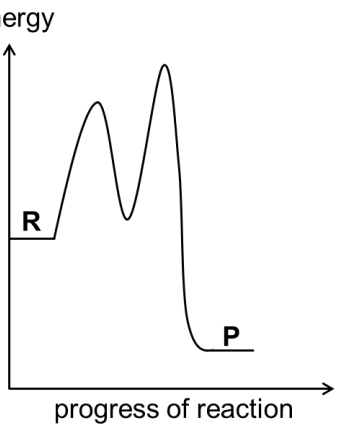
A 1 only **B** 1 and 2 **C** 2 and 3 **D** 1, 2 and 3

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

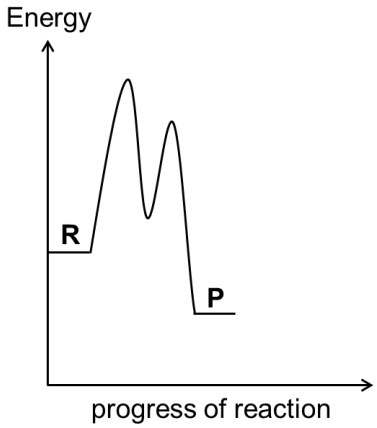
Ethanal undergoes addition reaction with HCN in the presence of $^{-}$CN ions to form a cyanohydrin.

Which of the energy profile best describes the reaction from ethanal, **R**, to its cyanohydrin product, **P**?

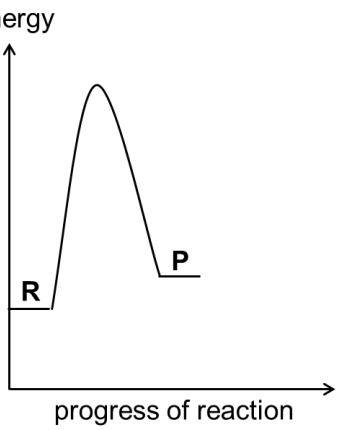
A



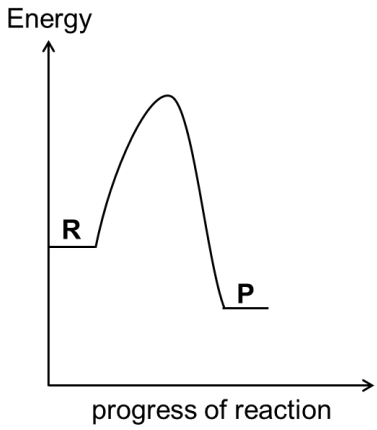
B



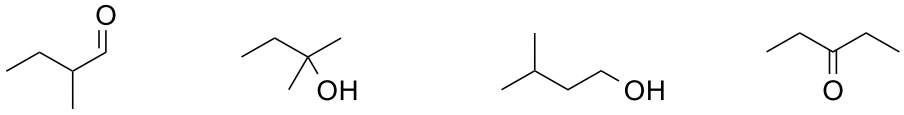
C



D



23 The structures of four compounds are shown below.



Which of the following pairs of reagents can be used to distinguish the four compounds from each other?

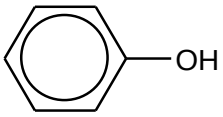
A sodium metal and alkaline potassium manganate (VIII)

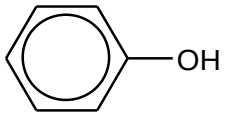
B 2,4-dinitrophenylhydrazine and sodium metal

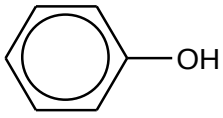
C alkaline potassium manganate (VIII) and Fehling's solution

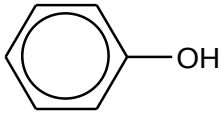
D Fehling's solution and sodium metal

24 Which of the following shows the correct order of increasing acidity?

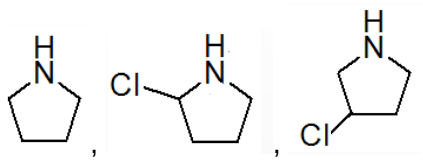
A  < CH_3CH_2OH < $CH_3CH_2CO_2H$ < CH_3CHFCO_2H

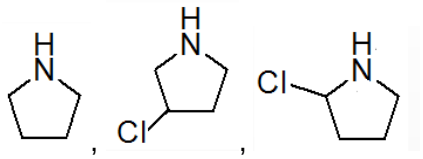
B CH_3CH_2OH <  < $CH_3CH_2CO_2H$ < CH_3CHFCO_2H

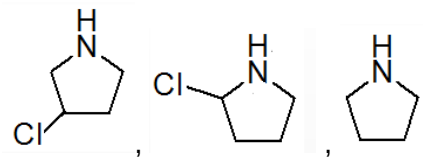
C CH_3CHFCO_2H < $CH_3CH_2CO_2H$ < CH_3CH_2OH < 

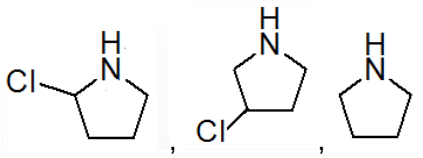
D CH_3CHFCO_2H < CH_3CH_2OH < $CH_3CH_2CO_2H$ < 

25 Which one of the following shows the given molecules arranged in order of decreasing pK_b values?

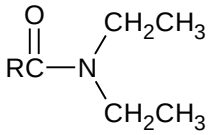
A 

B 

C 

D 

26 A hallucinogen has the following structure.



Which one of the following is likely to be formed when the hallucinogen is boiled with excess hydrochloric acid?

A $(CH_3CH_2)_2NH$ **B** $(CH_3CH_2)_2NH_2^+$

C $RCONH(CH_3CH_2)_2^+$ **D** $RCOO^-$

27 The following reaction has a negative E^{θ}_{cell} so it does not occur under standard conditions.

$$2NO_3^-(aq) + 8H^+(aq) + 6Cl^-(aq) \longrightarrow 2NO(g) + 4H_2O(l) + 3Cl_2(g)$$

However, the reaction may be made to proceed under non-standard conditions. Which of the following changes will **not** aid the reaction to proceed?

A Addition of NaC*l*

B Addition of HC*l*

C Addition of KNO_3

D Addition of AgC*l*

28 Which of the following statements is correct when a solution of $CuSO_4(aq)$ is electrolysed using pure Cu electrodes?

1 The cathode increases in size.

2 Oxygen gas is produced at the anode.

3 The blue solution fades over time.

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

29 Which properties of the first-row transition elements are correct?

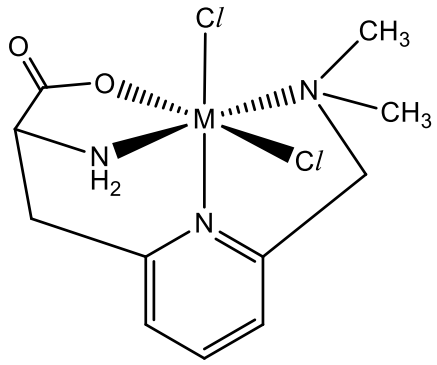
1 Atomic radius is relatively constant.

2 First ionisation energy is relatively constant.

3 They have variable oxidation states.

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

30 Which of the following statements regarding the metal complex below is **incorrect**?



A The oxidation number of M is +2.

B One of the ligands is an amino acid.

C The complex contains a tetradentate ligand.

D The complex contains 2 types of ligands.

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