

NANYANG JUNIOR COLLEGE
JC 2 PRELIMINARY EXAMINATION
Higher 2

CHEMISTRY

9647/01

Paper 1 Multiple Choice

27 September 2011

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, CT and NRIC / FIN on the Answer Sheet in the spaces provided.

There are **forty** questions in this paper. Answer **all** questions. For each question there are four possible answers **A, B, C** and **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Multiple Choice Answer Sheet 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.

You may use a calculator.

Section A

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

- A sample of 10 dm^3 of polluted air is passed through limewater so that all the carbon dioxide present is precipitated as calcium carbonate. The mass of calcium carbonate formed is 0.05 g . What is the percentage, by volume, of carbon dioxide in the air sample?
[A_r C, 12.0; O, 16.0; Ca, 40.1]

A 0.03% **B** 0.05% **C** 0.12% **D** 0.6%
- In an experiment, 100 cm^3 of $0.020 \text{ mol dm}^{-3}$ acidified iron (II) sulphate solution is quantitatively oxidized by 50 cm^3 of a solution containing $0.020 \text{ mol dm}^{-3}$ of an oxidizing agent, XO_3^- . What is the final oxidation state of X?

A -1 **B** -2 **C** $+2$ **D** $+3$
- A vessel at standard pressure and temperature contains a mixture of $^{35}\text{Cl}_2$ and $^{37}\text{Cl}_2$. The gaseous mixture occupies a volume of 5.6 dm^3 and weighs 18 g , calculate the percentage by mass of $^{35}\text{Cl}_2$ in the mixture.

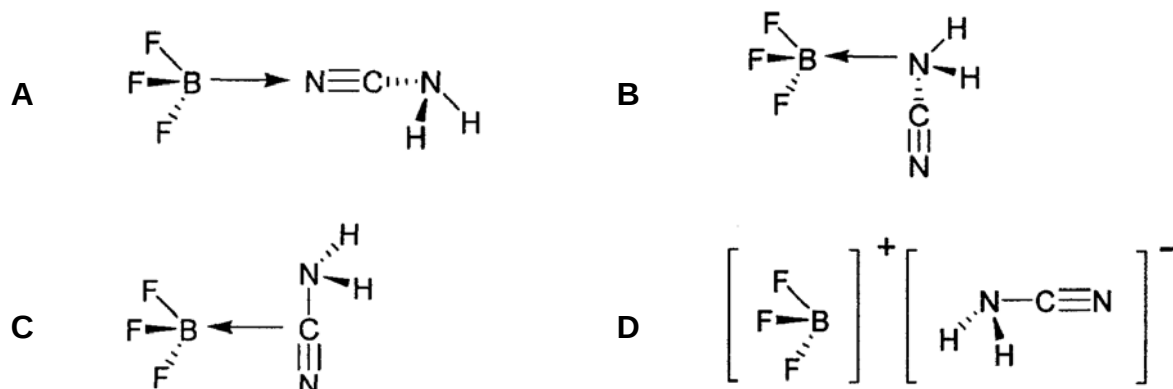
A 25% **B** 40% **C** 50% **D** 75%
- Equal masses of gaseous N_2 , NH_3 and N_2O are injected into an evacuated vessel to produce a total pressure of 3 atm . How do the partial pressures of N_2 , NH_3 and N_2O compare?

A $P_{\text{N}_2} = P_{\text{NH}_3} = P_{\text{N}_2\text{O}}$ **B** $P_{\text{N}_2} < P_{\text{NH}_3} < P_{\text{N}_2\text{O}}$

C $P_{\text{NH}_3} < P_{\text{N}_2} < P_{\text{N}_2\text{O}}$ **D** $P_{\text{N}_2\text{O}} < P_{\text{N}_2} < P_{\text{NH}_3}$
- Which of the following molecules/ions has the smallest bond angle?

A AlH_4^- **B** SO_3^{2-} **C** XeF_2 **D** SF_2

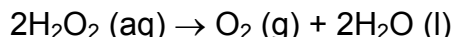
6. Cyanamide, NH_2CN , can form a product with boron trifluoride, BF_3 . Which of the following structures represents the product?



7. The enthalpy change of solution of magnesium fluoride is negative ($-17.7 \text{ kJ mol}^{-1}$) but the enthalpy change of solution of barium fluoride is positive ($+3.8 \text{ kJ mol}^{-1}$). What conclusion can be drawn from these data?

- A Magnesium fluoride is soluble in water, but barium fluoride is insoluble.
- B The hydration energy of the barium ion is numerically greater than that of the magnesium ion.
- C The lattice energy of barium fluoride is numerically greater than that of the magnesium fluoride.
- D The lattice energy of barium fluoride is numerically greater than the sum of the hydration energies of the barium and fluoride ions.

8. Hydrogen peroxide decomposes in the presence of a catalyst according to the equation below.



To determine the order of the reaction with respect to hydrogen peroxide, a student performed an experiment using the method below.

The method is as follows:

- Starting the reaction: the reactants H_2O_2 and catalyst are mixed and a stop-clock started.
- At measured time intervals, samples of the reaction mixture can be extracted.
- Noting the time, the reaction is **quenched** by rapidly adding it to a large beaker of cold water.
- The concentration of the unreacted hydrogen peroxide remaining in each sample can be found by titrating with standard potassium manganate(VII):

Which of the following statements is **false**?

- A** The solution is “quenched” to reduce the rate of reaction.
- B** The order of reaction with respect to hydrogen peroxide can be determined from the graph of volume of potassium manganate(VII) against time, using the half-life method.
- C** The end-point of the titration is marked by the disappearance of the pink colour.
- D** Alternatively, the order of the reaction can be studied by measuring the pressure of the system at measured time intervals.

9. The initial rates of the reaction between NO and O_2 were obtained by changing the pressures according to the table below.

Experiment No.	Initial total pressure / atm	Initial pressure of NO / atm	Initial rate / atm s^{-1}
1	5	2	5.4
2	8	2	10.8
3	10	4	43.2

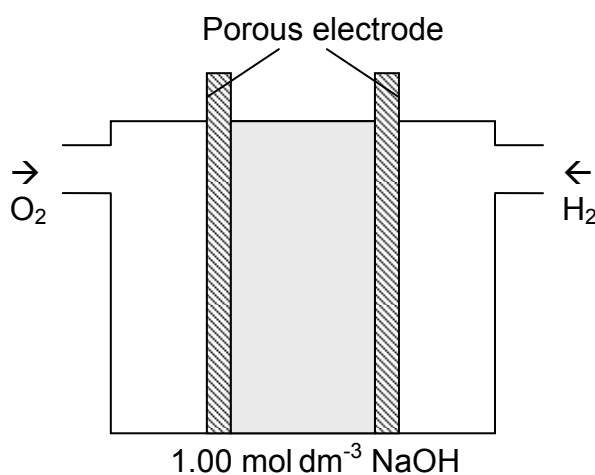
Which of the statements is true about the system above?

- A** The order of the reaction with respect to NO is 1.
- B** The overall order of the reaction is 3.
- C** The rate constant k has units of s^{-1} .
- D** The rate constant k increases as the initial total pressure increases.

10. From which of the following reactions can the bond energy of the O—H bond be determined by using only the standard enthalpy change of the reaction?

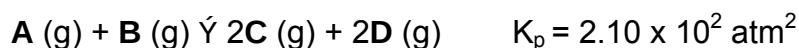
- A $2 \text{H (g)} + \text{O (g)} \rightarrow \text{H}_2\text{O (g)}$
 B $\frac{1}{2} \text{H}_2\text{O (l)} \rightarrow \text{H (g)} + \frac{1}{2} \text{O (g)}$
 C $\text{H}_2 \text{(g)} + \frac{1}{2} \text{O}_2 \text{(g)} \rightarrow \text{H}_2\text{O (g)}$
 D $\text{H}_2\text{O (l)} \rightarrow \text{H}_2\text{O (g)}$

11. The diagram below is a hydrogen-oxygen fuel cell. Predict the changes in the pH of the solution around each of the electrode when a current is flowing.



- | | Cathode | Anode |
|---|----------------|--------------|
| A | increase | decrease |
| B | decrease | decrease |
| C | decrease | increase |
| D | increase | increase |

12. Given the following reaction:



An equimolar mixture of **A** and **B** is allowed to reach equilibrium at 700 K. Determine the total pressure at equilibrium if the partial pressure of **C** at equilibrium was found to be 2.00 atm.

- A 1.28 atm B 4.00 atm C 4.28 atm D 4.56 atm

13. The numerical value for the solubility product of calcium phosphate, $\text{Ca}_3(\text{PO}_4)_2$, is 2.07×10^{-33} .

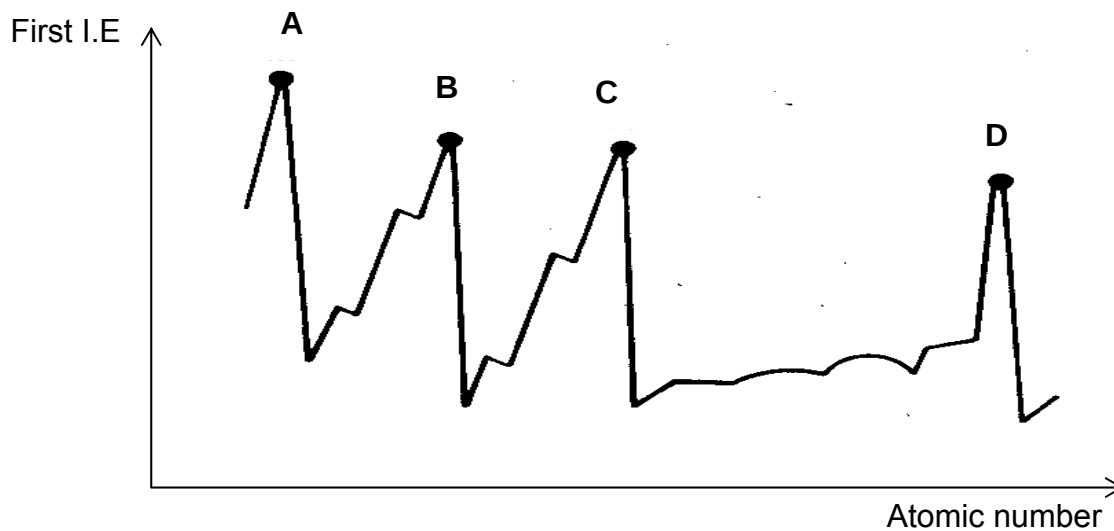
Determine the solubility of $\text{Ca}_3(\text{PO}_4)_2$.

- | | | | |
|----------|---|----------|---|
| A | $2.28 \times 10^{-7} \text{ mol dm}^{-3}$ | B | $1.14 \times 10^{-7} \text{ mol dm}^{-3}$ |
| C | $3.42 \times 10^{-7} \text{ mol dm}^{-3}$ | D | $2.91 \times 10^{-7} \text{ mol dm}^{-3}$ |

14. Which of the following solutions is unable to maintain a fairly constant pH when a small amount of acid is added to it?

- A** 20 cm^3 of $0.1 \text{ mol dm}^{-3} \text{ NH}_3$ with 10 cm^3 of $0.1 \text{ mol dm}^{-3} \text{ H}_2\text{SO}_4$
- B** 20 cm^3 of $0.1 \text{ mol dm}^{-3} \text{ NaOH}$ with 20 cm^3 of $0.2 \text{ mol dm}^{-3} \text{ CH}_3\text{COOH}$
- C** 0.25 mol KHCO_3 with $0.30 \text{ mol K}_2\text{CO}_3$
- D** 2-amino-2-methylethanoic acid

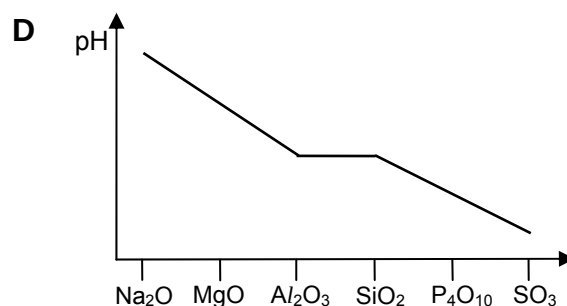
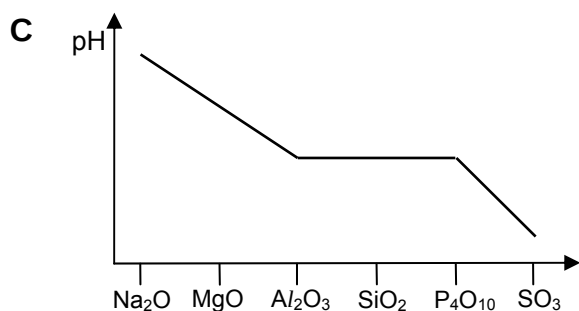
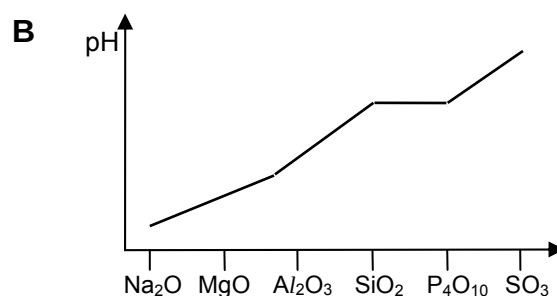
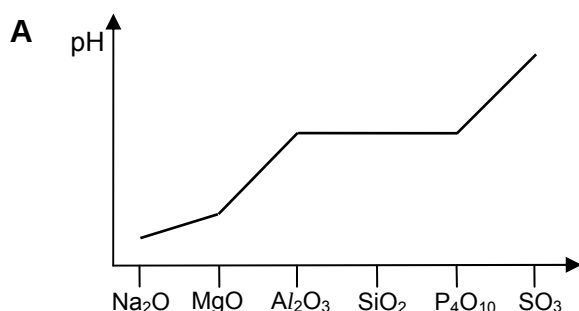
15. The graph below shows the first ionisation energies of elements in the Periodic Table plotted against increasing atomic number.



What are the elements indicated by the letters **A**, **B**, **C** and **D**?

- | | | | |
|----------|----------------|----------|---------------------|
| A | Group I metals | B | Group VII halogens |
| C | Noble gases | D | Transition elements |

16. The highest oxides of the elements sodium to sulphur are separately added to water. Which of the following diagrams best represents the pH of the solution produced?



17. Which of the following property of Group II elements decreases from beryllium to barium?

- A** reactivity with water
B stability of the carbonates
C solubility of hydroxides
D second ionisation energy

18. Which of the following are the anions present when chlorine gas is passed through hot concentrated potassium hydroxide.

- A** ClO^- , ClO_3^- **B** Cl^- , ClO_4^-
C Cl^- , ClO^- **D** Cl^- , ClO_3^-

19. What is the electronic configuration of the nickel cation which can form the complex ion $[\text{Ni}(\text{CN})_4]^{2-}$?

($[\text{Ar}] \equiv 1s^2 2s^2 2p^6 3s^2 3p^6$)

A $[\text{Ar}] 3d^8 4s^0$

B $[\text{Ar}] 3d^6 4s^0$

C $[\text{Ar}] 3d^4 4s^2$

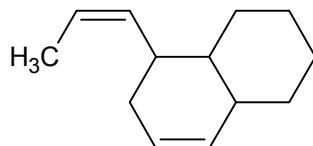
D $[\text{Ar}] 3d^6 4s^2$

20. A dilute solution of nickel (II) chloride is pale green at room temperature. When a test tube containing nickel (II) chloride is immersed in liquid nitrogen (temperature: -196°C), the pale green solution solidifies and becomes colourless.

Which of the following statements best explains the observations above?

- A The chloride ion has been substituted by a stronger ligand.
 B The probability of d-d transitions was greatly reduced.
 C The solution does not contain any complex ions at -196°C .
 D The oxidation state of nickel has changed from +2 to 0.

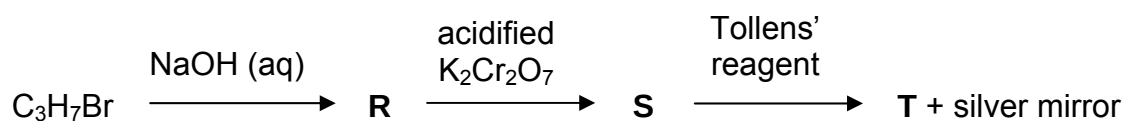
21.



How many stereoisomers does the above molecule have?

- A 8 B 10 C 16 D 32

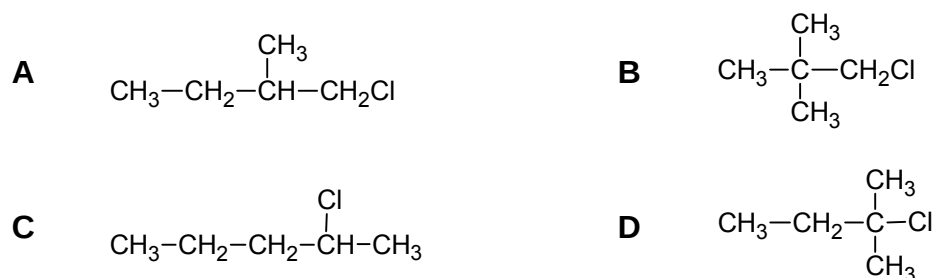
22. The compound $\text{C}_3\text{H}_7\text{Br}$ undergoes a sequence of reactions as follows:



What could be the formulae for **R**, **S** and **T**?

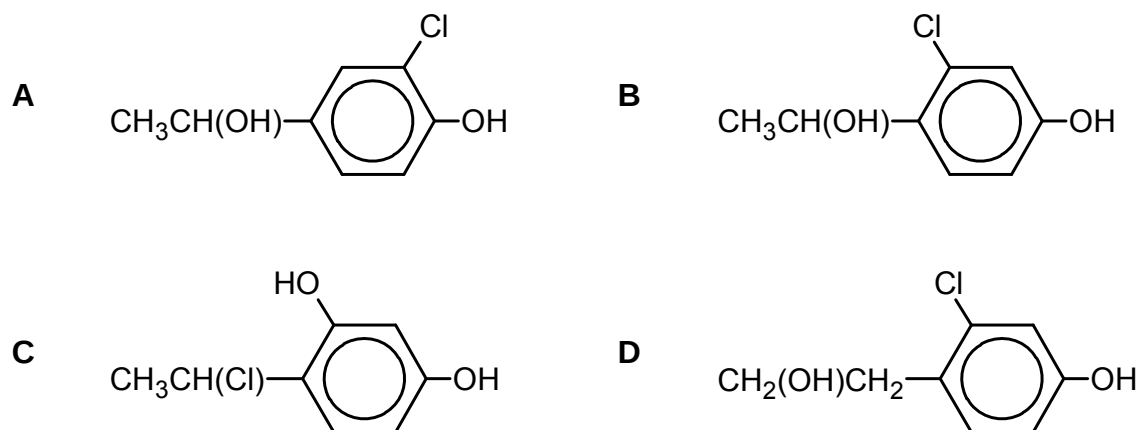
	R	S	T
A	$\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$	$\text{CH}_3\text{CH}_2\text{CHO}$	CH_3CO_2^-
B	$\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$	$\text{CH}_3\text{CH}_2\text{CHO}$	$\text{CH}_3\text{CH}_2\text{CO}_2^-$
C	$\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$	$\text{CH}_3\text{CH}_2\text{CO}_2\text{H}$	$\text{CH}_3\text{CH}_2\text{CHO}$
D	$\text{CH}_3\text{CH}(\text{OH})\text{CH}_3$	CH_3COCH_3	CH_3CO_2^-

23. Which of the chloroalkanes, with formula $\text{C}_5\text{H}_{11}\text{Cl}$, gives the largest number of isomeric products when heated with ethanolic potassium hydroxide?



24. Compound **E**, $\text{C}_8\text{H}_9\text{ClO}_2$, gives compound **F**, $\text{C}_8\text{H}_7\text{ClO}_2$, on **mild** oxidation. **F** gives a yellow precipitate on warming with alkaline iodine and reacts with 2 moles of aqueous bromine.

Which one of the following is the correct structure for **E**?

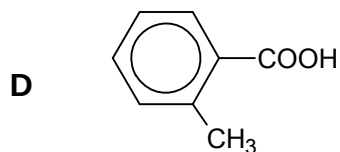
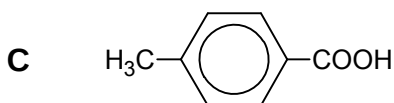
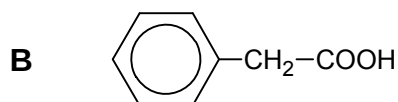
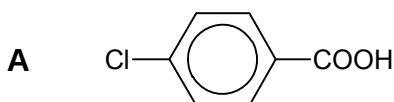


25. Compound Y is boiled with aqueous sodium hydroxide and the resulting mixture cooled and acidified with dilute sulphuric acid. The final products include a compound $C_3H_6O_2$ and an alcohol. The alcohol gives a positive iodoform test.

What is the formula for compound Y?

- A $CH_3CH_2CO_2CH_3$
- B $CH_3CH_2OCOCH_3$
- C $CH_3CH_2CO_2CH_2CH_3$
- D $HOCH_2CH_2CO_2CH_2CH_3$
26. What is the product of a nucleophilic substitution reaction between 2-iodobutane and sodium ethoxide ($CH_3CH_2O^- Na^+$)?
- A $CH_3CH=CHCH_3$
- B $CH_3CH_2CH(OCH_3)CH_2CH_3$
- C $CH_3CH_2CH(CH_3)OCH_2CH_3$
- D $(CH_3)_2CHCH_2OCH_2CH_3$
27. When ethyl ethanoate undergoes hydrolysis with dilute sulphuric acid in the presence of $H_2^{18}O$, a mixture of two products is formed. Which of the following pairs correctly gives the structures of the two products?
- A $CH_3CO^{18}OH$ and $CH_3CH_2^{18}OH$
- B CH_3COOH and $CH_3CH_2^{18}OH$
- C $CH_3C^{18}OOH$ and CH_3CH_2OH
- D $CH_3CO^{18}OH$ and CH_3CH_2OH

28. Which of the following molecules has the lowest pK_a ?



29. Which of the following statements explains why $\text{C}_6\text{H}_5\text{NH}_2$ is a weaker base than CH_3NH_2

- A The p orbital of nitrogen in $\text{C}_6\text{H}_5\text{NH}_2$ is able to overlap with the π orbital of carbon in benzene ring.
- B The methyl group in CH_3NH_2 is electron withdrawing, hence stabilising the ion formed on dissociation.
- C The electron rich C_6H_5 group in $\text{C}_6\text{H}_5\text{NH}_2$ is electron releasing.
- D $\text{C}_6\text{H}_5\text{NH}_2$ is less volatile than CH_3NH_2 .

30. Partial hydrolysis of a decapeptide (containing 10 amino acid residues) using an enzyme yielded the following tripeptide fragments:

His–Tyr–Arg, Gln–Thr–Asp, Arg–His–Tyr,
Tyr–Arg–Thr, Asp–Arg–His, Thr–Arg–Gln

Which of the following is the amino sequence of the decapeptide?

- A His–Tyr–Arg–Thr–Asp–Arg–Gln–Gln–Thr–Arg
- B Thr–Arg–Gln–Thr–Arg–His–Tyr–Thr–Asp–Arg
- C Thr–Asp–Arg–Gln–Thr–Arg–Thr –Arg–His–Tyr
- D Thr–Arg–Gln–Thr–Asp–Arg–His–Tyr–Arg–Thr

Section B

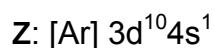
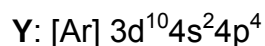
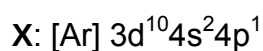
For each questions in this section, one or more of the three numbered statements **1** to **3** may be correct.

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 can be used as a correct response.

31. The electronic configuration of elements **X**, **Y**, and **Z** are as follows:



Which of the following statements are correct?

- 1** Compared to Y⁺ and Z²⁺, X³⁺ shows the greatest deflection towards the negatively charged plate with constant electric field.
- 2** The ions, X²⁺, Y²⁺ and Z²⁺, each contains at least one unpaired electron.
- 3** Compounds X₂Y₃, ZY and XZ₃ are likely to be formed.

32. Which of the following substances contains at least two types of bonds?

- | | | |
|---------------------------|-----------------------------|-------------------|
| 1 KHF ₂ | 2 NH ₄ Cl | 3 Graphite |
|---------------------------|-----------------------------|-------------------|

33. In which sequences are the molecules quoted in order of increasing boiling points?

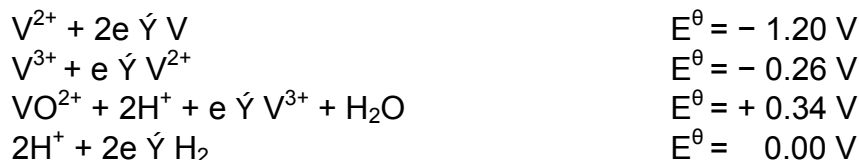
- 1** CH₃CH₂OH, (CH₂OH)₂, CH₃CONHCH₃
- 2** NH₃, H₂O, NH₂OH
- 3** I₂, HCl, HF

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 can be used as a correct response.

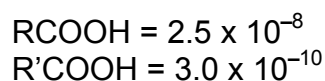
34. Given the following electrode potentials,



It can be inferred that the vanadium dissolves in 1 mol dm^{-3} hydrochloric acid to form



35. At 298 K, the dissociation constants for the carboxylic acids are given below:



It can be inferred that

- 1** the pH of 1 mol dm^{-3} $R'COOH$ is greater than 1 mol dm^{-3} $RCOOH$.
- 2** the K_b of $RCOO^-$ is smaller than that of $R'COO^-$.
- 3** the electrical conductivity of a solution of $RCOOH$ is greater than that of $R'COOH$ of the same concentration.

36. Copper(I) sulphate, Cu_2SO_4 , can be made from copper(I) oxide under non aqueous conditions. On adding this salt to water, it immediately undergoes disproportionation reaction to form $CuSO_4$ and Cu metal.

Which of the following statements are true?

- 1** A blue solution is formed upon adding Cu_2SO_4 to water.
- 2** The electronic configuration of Cu^+ in this salt is $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10}$
- 3** Cu_2SO_4 is a white solid.

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 can be used as a correct response.

- 37.** Which of the following particles are **not** formed in the steps indicated when ethane reacts with chlorine gas in ultraviolet light?

- | | | |
|----------|------------------|---|
| 1 | Propagation Step | CH_3CHCl_2 |
| 2 | Propagation Step | $\text{CH}_3\text{CH}_2\text{CHClCH}_3$ |
| 3 | Termination Step | HCl |

- 38.** Given the reaction below:



where *en* represents ethylenediammine, $\text{H}_2\text{NCH}_2\text{CH}_2\text{NH}_2$

Which of the following statements are **true** about this reaction?

- 1** The change in entropy is positive.
- 2** Both complexes are octahedral.
- 3** ΔH is approximately 0 and the reaction is spontaneous at all temperatures.

- 39.** Which of the following reagents will have different reactions with the two alcohols, $(\text{CH}_3)_3\text{CCH}_2\text{OH}$ and $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{OH}$?

- 1** concentrated sulfuric acid
- 2** phosphorus pentachloride
- 3** acidified aqueous potassium manganate(VII)

- 40.** Which of the following **cannot** be used to distinguish $\text{C}_6\text{H}_5\text{CHO}$ from $\text{C}_6\text{H}_5\text{COCH}_3$?

- 1** warm ammoniacal silver nitrate
- 2** Fehling's solution
- 3** 2,4-DNPH