



CHEMISTRY

9729/01

Paper 1 Multiple Choice

24 September 2018

1 hour

Additional Materials: Multiple Choice Answer Sheet
Data Booklet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, glue or correction fluid.

Write your name, civics group and registration number on the Answer Sheet in the spaces provided unless this has been done for you.

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

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

Read the instructions on the Answer Sheet very carefully.

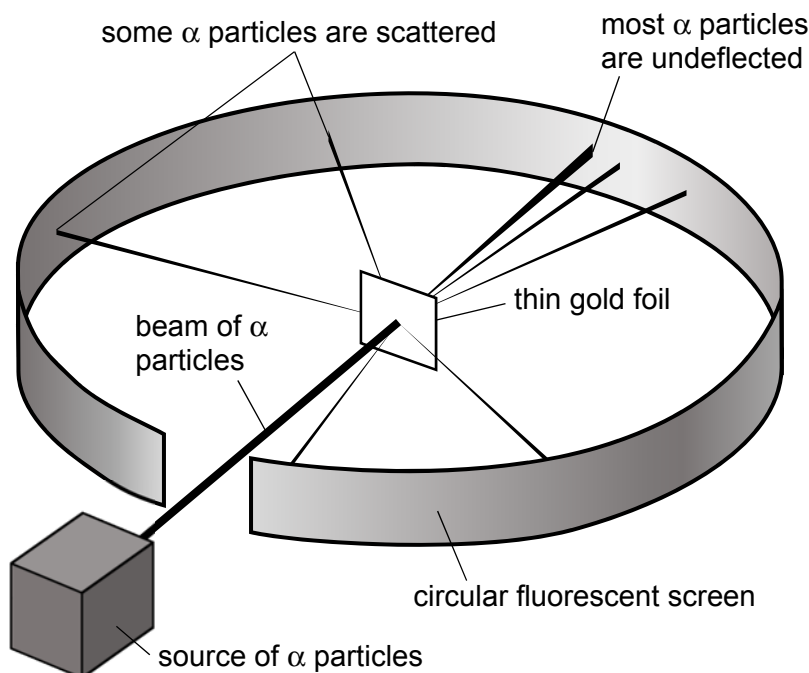
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this question paper.

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

- 1 Following J. J. Thomson's discovery of the electron in 1897, Ernest Rutherford devised the celebrated gold foil experiment, which led to a better understanding of the structure of the atom. In the experiment, a beam of heavy α particles, ${}^4_2\text{He}^{2+}$, was fired at a piece of thin gold foil as target.

As expected, most of the α particles passed straight through the gold foil undeflected. However, some α particles are scattered, and a small number in fact deflected right back to the source.



Which of the following conclusions **cannot** be drawn from the gold foil experiment?

- A Atom is mostly empty space.
 - B Atom possesses a region of positive charge.
 - C Electrons in atom orbit around a dense positively charged region.
 - D The positive charge in an atom is concentrated within a very small volume.
- 2 The most common oxidation state of americium, Am, in aqueous solution is $+n$.

Recently, Cu^{3+} has been shown to quantitatively oxidise $\text{Am}^{n+}(\text{aq})$ in dilute HNO_3 to the $+2n$ oxidation state, while itself is reduced to Cu^{2+} .

In an experiment, 25.0 cm^3 of $0.0100 \text{ mol dm}^{-3}$ $\text{Am}^{n+}(\text{aq})$ was found to require 15.0 cm^3 of $0.0500 \text{ mol dm}^{-3}$ Cu^{3+} for complete oxidation.

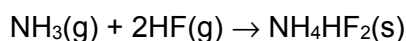
What is the formula of the americium containing species formed?

- A Am^{2+}
- B AmO_2
- C AmO_2^+
- D AmO_2^{2+}

- 3 In which sequences are the molecules quoted in order of increasing bond angle around the central atom within the molecule?

A	OF ₂	CH ₄	SF ₆
B	H ₂ O	O ₃	N ₂ O
C	PF ₃	BF ₃	IF ₃
D	NO ₂	SO ₂	CO ₂

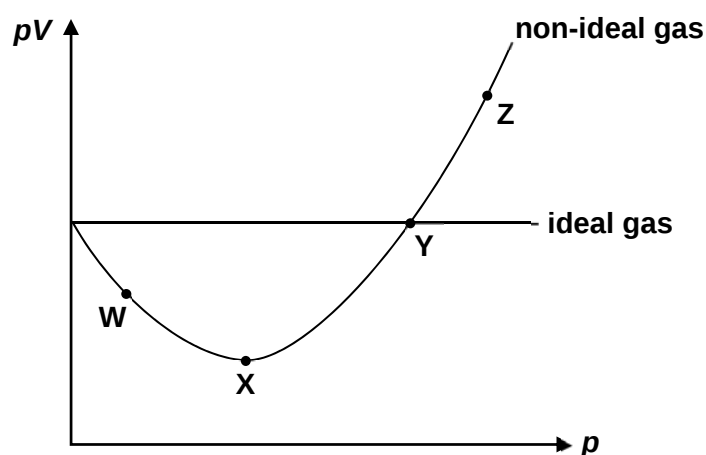
- 4 Unlike the reaction of ammonia with hydrogen chloride to give ammonium chloride, the reaction of ammonia with hydrogen fluoride produces colourless crystals of ammonium bifluoride, NH₄HF₂, which contains the bifluoride ion, HF₂⁻:



Which of the following chemical bonds are present in the ammonium bifluoride crystals?

- 1 ionic bond
- 2 dative bond
- 3 hydrogen bond

- A** 1, 2 and 3
B 1 and 2 only
C 2 and 3 only
D 1 only
- 5 The value of pV is plotted against p for two gases, an ideal gas and a non-ideal gas, where p is the pressure and V is the volume of the gas.



At which points on the graph, is the intermolecular forces of attraction within the non-ideal gas, the dominant factor accounting for deviation from ideal gas behavior?

- | | |
|--------------------------|--------------------------|
| A W only | B W and X only |
| C W, X and Y only | D W, X and Z only |

- 6 There are conflicting interpretations for the origin of the acidity of aqueous boric acid, B(OH)_3 . Some believe that the acidity is exclusively from the following equilibria:

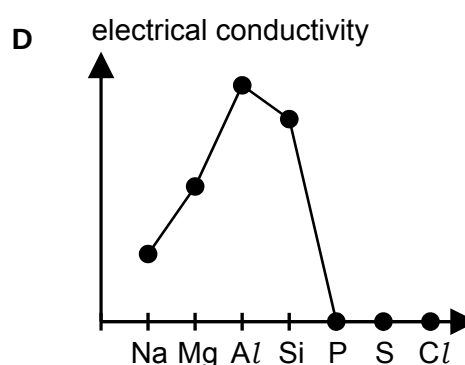
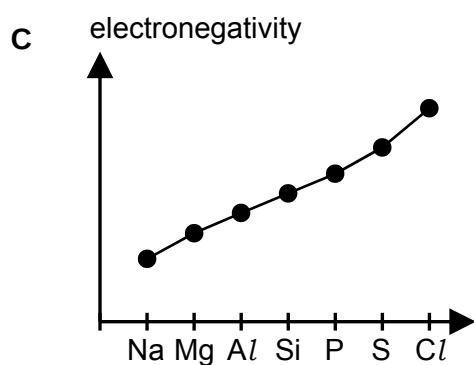
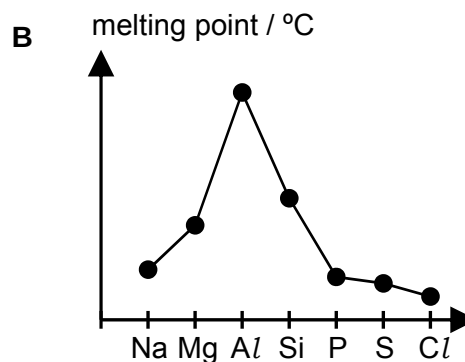
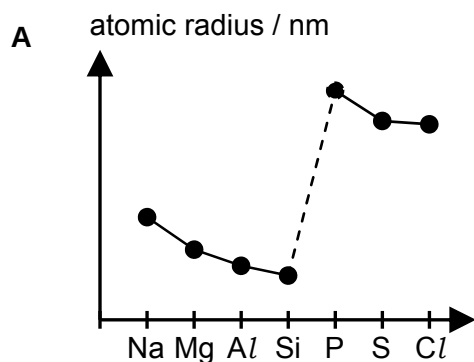


Which of the following statements pertaining to this interpretation of the acidity of boric acid is **incorrect**?

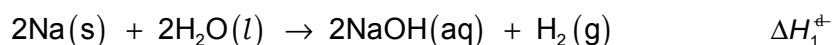
- A Boric acid is an Arrhenius acid.
 - B Boric acid is a Brønsted-Lowry acid.
 - C Boric acid is a Lewis acid.
 - D Boric acid is a weak monobasic acid.
- 7 Chlorides of Period 3 elements dissolve in water to form aqueous solutions.

Which of the following sequence shows the order of increasing pH of the resultant solutions formed when these compounds are dissolved in water?

- A $\text{Al}_2\text{Cl}_6 < \text{MgCl}_2 < \text{NaCl}$
 - B $\text{MgCl}_2 < \text{Al}_2\text{Cl}_6 < \text{SiCl}_4$
 - C $\text{PCl}_5 < \text{MgCl}_2 < \text{Al}_2\text{Cl}_6$
 - D $\text{SiCl}_4 < \text{Al}_2\text{Cl}_6 < \text{PCl}_5$
- 8 For the elements in Period 3 of the Periodic Table, which of the following sketches shows the correct trend in the stated property?



- 9 Sodium reacts with water to form sodium hydroxide and hydrogen.



What information is needed in order to calculate the standard enthalpy change of reaction, $\Delta H_1^\ddagger$?

- 1 $\Delta H_c^\ddagger$ for $\text{H}_2\text{(g)}$
- 2 $\Delta H_c^\ddagger$ for $\text{H}_2\text{O(l)}$
- 3 $\Delta H_f^\ddagger$ for NaOH(aq)
- 4 $\Delta H_c^\ddagger$ for Na(s)

- A 1 and 2 only
- B 1 and 3 only
- C 2 and 3 only
- D 1, 2 and 4 only

- 10 Which reaction represents a standard enthalpy change at 298 K?

- A $\frac{1}{2}\text{O}_2\text{(g)} \rightarrow \text{O(g)}$
- B $\text{C(g)} + \text{O}_2\text{(g)} \rightarrow \text{CO}_2\text{(g)}$
- C $2\text{C(s)} + 6\text{H(g)} \rightarrow \text{C}_2\text{H}_6\text{(g)}$
- D $\text{CH}_4\text{(g)} + 2\text{O}_2\text{(g)} \rightarrow \text{CO}_2\text{(g)} + 2\text{H}_2\text{O(g)}$

- 11 The reaction between A(aq) and B(aq) has a rate constant of $9 \times 10^{-3} \text{ mol}^{-2} \text{ dm}^6 \text{ s}^{-1}$.

Which one of the following is a possible rate equation for this reaction?

- A $\text{rate} = k[\text{B(aq)}]$
- B $\text{rate} = k[\text{A(aq)}]^2$
- C $\text{rate} = k[\text{A(aq)}][\text{B(aq)}]^2$
- D $\text{rate} = k[\text{A(aq)}]^2[\text{B(aq)}]^2$

- 12** The half-life of the first order gaseous reaction in which X_2 molecules become converted into X atoms is 20 minutes.

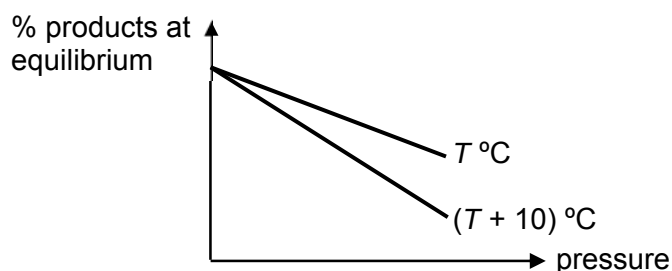
1 mol of X_2 is put into a sealed vessel at pressure p .

Which of the following will be correct when 87.5% of X_2 has been converted into X atoms?

- 1 60 minutes have elapsed.
- 2 1.75 mol of X atoms have been formed.
- 3 The total pressure is $\frac{15p}{8}$ (at constant temperature).

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

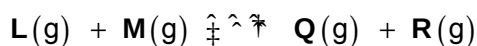
- 13** The graphs below show how the percentage of gaseous products present at equilibrium vary with temperature and pressure.



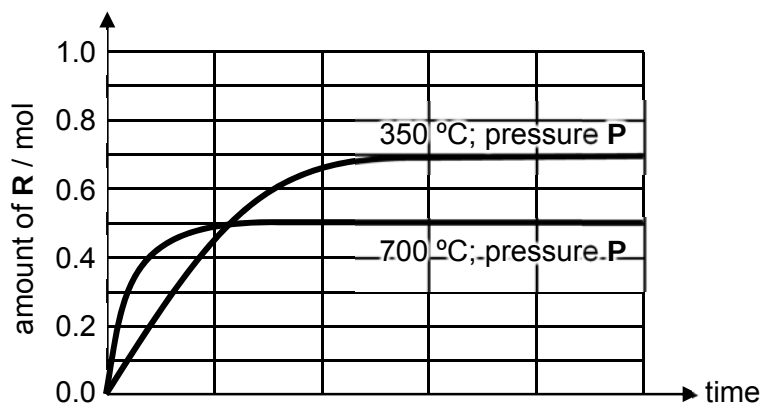
Which one of the following reactions could the graph represent?

- | | | |
|----------|--|---------------------------------------|
| A | $N_2O_4(g) \rightleftharpoons 2NO_2(g)$ | $\Delta H = +57 \text{ kJ mol}^{-1}$ |
| B | $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$ | $\Delta H = +53 \text{ kJ mol}^{-1}$ |
| C | $2C(s) + O_2(g) \rightleftharpoons 2CO(g)$ | $\Delta H = -221 \text{ kJ mol}^{-1}$ |
| D | $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ | $\Delta H = -92 \text{ kJ mol}^{-1}$ |

- 14 L and M can react together to reach equilibrium in the reaction below.



In an experiment, 1.0 mole each of L and M were reacted at constant pressure P and temperature 350 °C. The amount of R present in the mixture at intervals of time was recorded. The experiment was repeated at the same pressure P, but at a temperature of 700 °C. The results for both experiments are shown below.



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

- A The value of K_p at 350 °C.
 - B The forward reaction is exothermic.
 - C The activation energy of the forward reaction is high.
 - D The equilibrium is achieved at a faster rate at higher temperatures.
- 15 The table gives the concentrations and pH values of the aqueous solutions of three compounds, X, Y and Z at 25 °C. Each compound could be an acid or a base.

	X	Y	Z
concentration	$1.00 \times 10^{-4} \text{ mol dm}^{-3}$	1.00 mol dm^{-3}	1.00 mol dm^{-3}
pH	4	3	14

A final year student made the following conclusions:

- 1 X is a strong acid and Z is a strong base.
- 2 The extent of dissociation of X(aq) is higher than in Y(aq).
- 3 Mixture of equal volume of Y and Z will give a resulting solution of pH > 7.

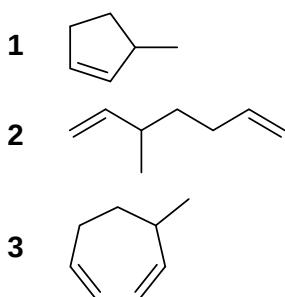
Which of the above conclusions are **correct**?

- A Conclusion 1 only
- B Conclusion 2 only
- C Conclusions 2 and 3 only
- D All three conclusions are correct

- 16 In which of the following solution will solid silver phosphate, Ag_3PO_4 , be the least soluble at 25 °C?

Given that the numerical value of $K_{\text{sp}}(\text{Ag}_3\text{PO}_4) = 8.89 \times 10^{-17}$.

- A pure water
 B $0.10 \text{ mol dm}^{-3} \text{ AgNO}_3(\text{aq})$
 C $0.10 \text{ mol dm}^{-3} \text{ NH}_3(\text{aq})$
 D $0.10 \text{ mol dm}^{-3} \text{ Na}_3\text{PO}_4(\text{aq})$
- 17 Which compound exhibits both *cis-trans* and enantiomerism?
- A $\text{CH}_3\text{CH}_2\text{CHBrCH}=\text{CHBr}$
 B $\text{CH}_3\text{CH}=\text{CHCH}_2\text{CH}_3$
 C $\text{CH}_3\text{CHBrCH}=\text{CH}_2$
 D $\text{CH}_3\text{CBr}=\text{CBrCH}_3$
- 18 Which structural formula represents 2,2-dimethylpentane?
- A $(\text{CH}_3)_3\text{CCH}(\text{CH}_3)_2$
 B $(\text{CH}_3)_3\text{CCH}_2\text{C}(\text{CH}_3)_3$
 C $\text{CH}_3\text{CH}_2\text{CH}_2\text{C}(\text{CH}_3)_3$
 D $(\text{CH}_3)_2\text{CHCH}_2\text{CH}(\text{CH}_3)_2$
- 19 Which of the following hydrocarbons would give the same organic product upon oxidation with hot acidified KMnO_4 ?

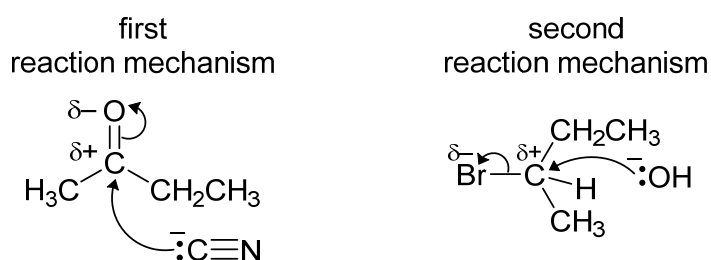


- A 1, 2 and 3 are correct
 B 1 and 2 only are correct
 C 2 and 3 only are correct
 D 1 and 3 only are correct

20 Which of the following compounds reacts with benzene under suitable conditions to form $\text{C}_6\text{H}_5\text{COC}_6\text{H}_5$?

- A $\text{C}_6\text{H}_5\text{CHO}$
- B $\text{C}_6\text{H}_5\text{COOH}$
- C $\text{C}_6\text{H}_5\text{CH}_2\text{OH}$
- D $\text{C}_6\text{H}_5\text{COCl}$

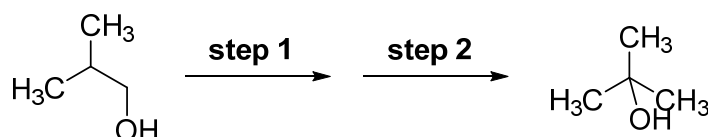
21 The **rate-determining step** of two different reaction mechanisms are shown below:



What do both reaction mechanism steps have in common?

- A Intermediates are formed.
- B They involve addition of nucleophile.
- C The overall rate of reaction is second order.
- D The products formed can rotate plane polarised light.

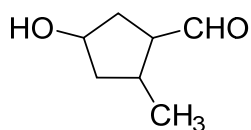
22 2-methylpropan-1-ol can be converted into 2-methylpropan-2-ol in two steps.



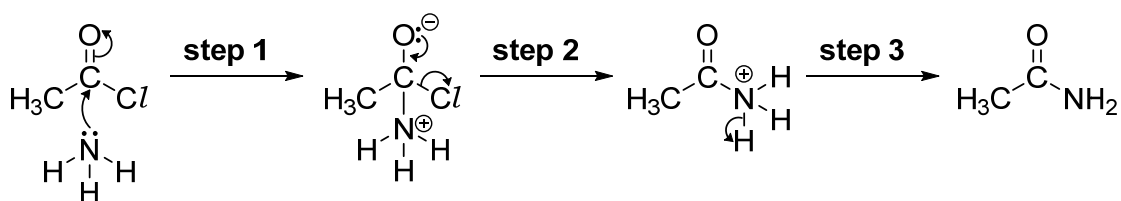
Which one of the following sequences may be used for the conversion?

- | step 1 | step 2 |
|--|--|
| A PCl_5 at r.t.p. | NaOH(aq) , heat |
| B conc. H_2SO_4 , heat | alkaline KMnO_4 , cold |
| C Al_2O_3 with heating | H_2O with H_3PO_4 at high temperature and pressure |
| D alcoholic NaOH | dilute H_2SO_4 |

- 23 Tollens' reagent is added to the following organic compound and warmed. What are the products formed as a result?



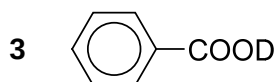
- A Silver mirror and an organic compound containing a carboxylic acid
 B Silver mirror and an organic compound containing a carboxylate salt
 C Silver mirror and an organic compound containing a ketone and a carboxylic acid
 D Silver mirror and an organic compound containing a ketone and a carboxylic salt
- 24 The reaction between ammonia and ethanoyl chloride proceeds *via* the nucleophilic acyl substitution mechanism shown below.



Which of the statements is **incorrect** about the above mechanism?

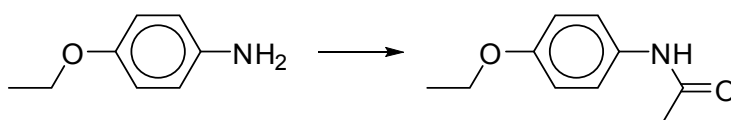
- A Ammonia behaves as a nucleophile.
 B Arrow pushing in **step 2** has been shown correctly.
 C Ethanoyl chloride behaves as an electrophile.
 D Proton loss in **step 3** has been shown correctly.
- 25 Phenyl propanoate undergoes acid hydrolysis in the presence of water labelled with the deuterium ^2D isotope.

Which of the following products are formed?



- A Only 1
 B 1 and 2 only
 C 1 and 3 only
 D 1, 2 and 3

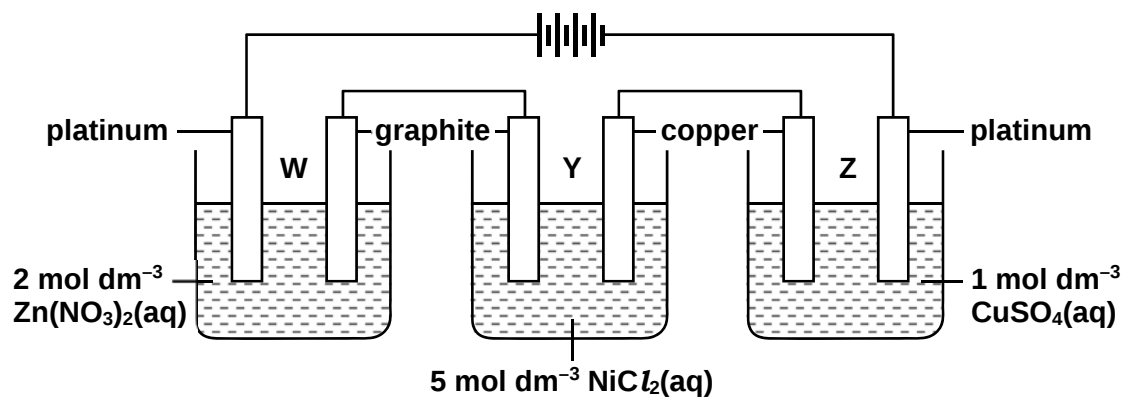
26 The synthesis of an aromatic amide from compound **X** is shown below.



What is the most suitable reagent to use in this synthesis?

- A CH_3COCl
 B CH_3COCH_3
 C CH_3CONH_2
 D CH_3COOH
- 27 Which of the following shows the nitrogen compounds arranged in order of increasing $\text{p}K_{\text{b}}$ values?
- A $\text{NH}_3 < \text{CH}_3\text{NH}_2 < (\text{CH}_3)_2\text{NH}$
 B $\text{CH}_3\text{CH}_2\text{NH}_2 < \text{NH}_3 < \text{C}_6\text{H}_5\text{NH}_2$
 C $\text{CH}_3\text{CH}_2\text{NH}_2 < (\text{C}_2\text{H}_5)_2\text{NH} < \text{C}_6\text{H}_5\text{NH}_2$
 D $\text{C}_6\text{H}_5\text{NH}_2 < \text{NH}_3 < \text{CH}_3\text{CH}_2\text{NH}_2$
- 28 Use of the Data Booklet is relevant to this question.

The following electrolytic cell is set up.

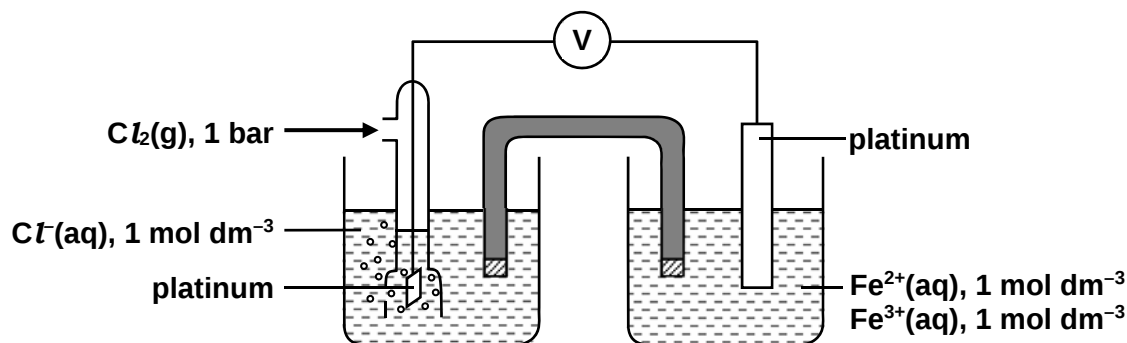


What is the ratio of the volume of gas formed at the anode in cell **W** : cell **Y** : cell **Z**?

- A 1 : 1 : 1 B 1 : 2 : 1 C 1 : 1 : 0 D 1 : 2 : 0

29 Use of the Data Booklet is relevant to this question.

The cell shown below is set up.

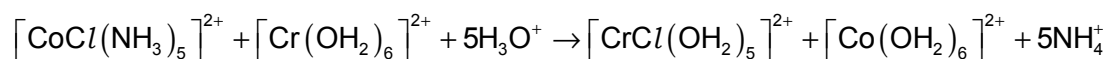


Which statements are correct?

- 1 The voltmeter will register an initial reading of 0.59 V, which decreases gradually with time.
- 2 Addition of a few crystals of silver(I) nitrate to the left-hand-side half-cell will cause the voltmeter reading to increase.
- 3 Addition of excess solid sodium cyanide to the right-hand-side half-cell will cause the voltmeter reading to increase.

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

30 Which of the following processes is **not** involved in the following reaction between the two transition metal complexes in acidic medium?



- A electron transfer
 B hydration
 C ligand exchange
 D neutralisation

Answer :

Question	Answer	Question	Answer
1	C	16	B
2	D	17	A
3	B	18	C
4	A	19	A
5	B	20	D
6	B	21	C
7	A	22	C
8	C	23	B
9	B	24	D
10	A	25	B
11	C	26	A
12	D	27	B
13	C	28	D
14	C	29	D
15	D	30	B