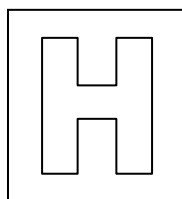


Candidate Name: _____

Class Adm No

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2011 Preliminary Examination II

Pre-university 3

H2 CHEMISTRY

9647/01

Paper 1 Multiple Choice

22 September 2011

Candidates answer on separate paper.

1 hour

Additional Materials: Multiple Choice Answer Sheet
Data Booklet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

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

Write your name and class on all the Answer Sheet in the spaces provided.

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 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.

This question paper consists of 14 printed pages.

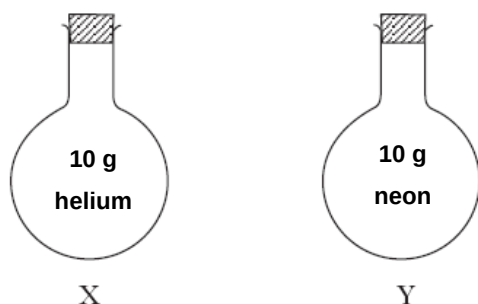
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SECTION A (30 MARKS)

Answer all questions on the OMR form provided

1. When a water molecule accepts a proton to form an hydronium ion, the magnitude of the change in bond angle is
- A 2.5°
B 15.5°
C 60.0°
D 5.0°

2.



The number of atoms of gas in flask X is approximately

- A one-fifth the number of atoms of gas in flask Y.
B equal the number of atoms of gas in flask Y.
C half the number of atoms of gas in flask Y.
D five times the number of atoms of gas in flask Y.
3. The use of the *Data Booklet* may be necessary for this question.

Successive ionization energy (I.E.) of element Z was tabulated:

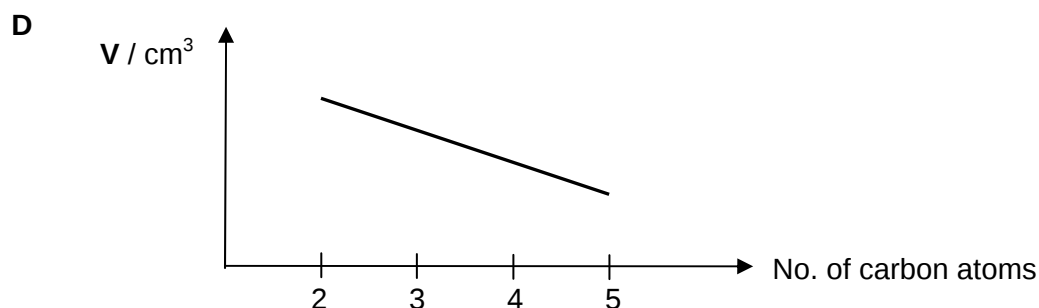
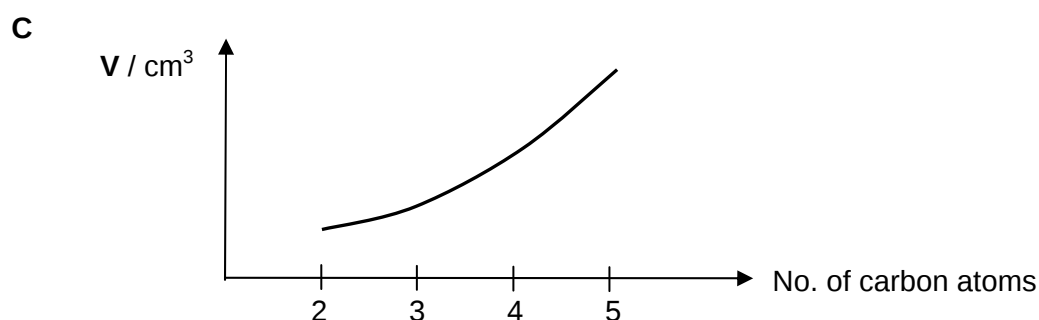
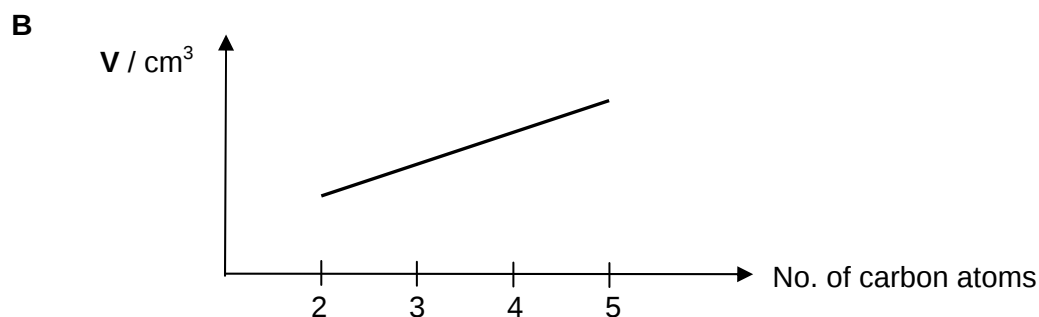
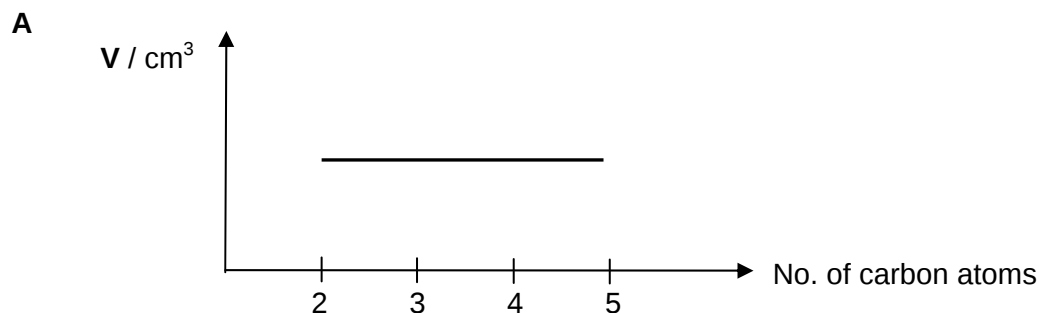
No. of e ⁻ removed	1	2	3	4	5	6	7	8	9
I.E. / kJ mol ⁻¹	1351	2350	3565	5070	6240	7570	10710	12138	22274

The likely identity of Z is

- A Chlorine
B Bromine
C Argon
D Krypton

4. Samples of 100 cm^3 of the first four members of the alkene homologous series are burnt in 800 cm^3 of oxygen. The total volume, V , of residual gas is measure at room temperature and pressure.

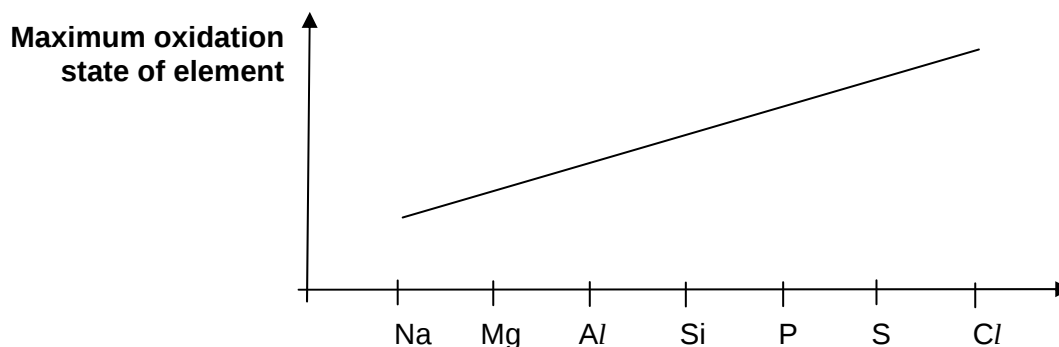
Which one of the following graphs represents the results that will be obtained?



5. Which of the following chlorides is likely to have the **least** ionic character?

- A** CsCl
- B** LiCl
- C** BeCl_2
- D** CaCl_2

6. The variation in oxidation states across Period 3 oxides is shown in the graph below.



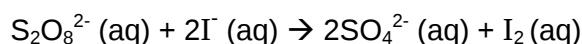
The trend above is best explained by

- A the variation in first ionisation energy of Period 3 elements across the Period.
B increase in electronegativity of the elements across Period 3.
C the presence of partially filled 3p subshell.
D the stability of the oxides increases across the Period.
7. 0.831 g of gas was released into a 8.31 dm³ vessel at standard temperature. The pressure of the gas was found to be 5.2 kPa.

What is the relative molecular mass of the gas?

- A $\frac{22.4 \times 0.831}{8.31}$
B $\frac{0.831 \times 273}{5.2 \times 8.31}$
C $\frac{0.831 \times 273}{5.2}$
D $\frac{0.831 \times 298}{5.2}$

8. The rate equation for a reaction



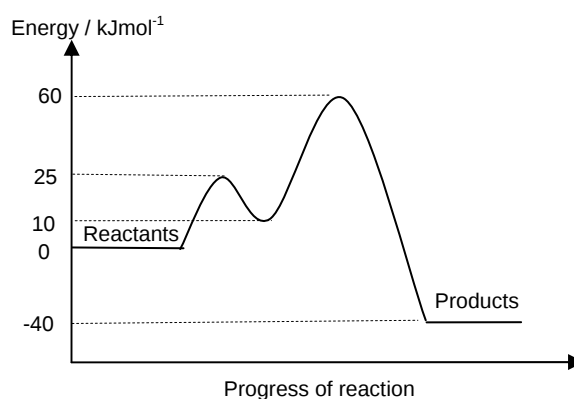
is given as rate = $k [\text{S}_2\text{O}_8^{2-}] [\text{I}^-]$ where k is the rate constant.

The reaction with initial concentrations of $\text{S}_2\text{O}_8^{2-}$ at $1 \times 10^{-4} \text{ mol dm}^{-3}$ and I^- at $9 \times 10^{-1} \text{ mol dm}^{-3}$ was investigated. A graph of $\text{S}_2\text{O}_8^{2-}$ against time was plotted and the half life was determined to be 40 s. Determine the value of the rate constant, k .

- A 0.0173
B 0.0193
C 173
D 278

9. Zinc solid was added to aqueous hydrochloric acid in a conical flask.
A suitable method to investigate the kinetics of a reaction between zinc and hydrochloric acid is to measure
- A the mass of the conical flask with its contents against time.
 - B the colour intensity of the mixture against time.
 - C the temperature of the mixture against volume of hydrochloric acid added.
 - D the mass of precipitate formed against time.
10. The lattice energies of KI , RbCl and NaCl are -613 kJ mol^{-1} , -659 kJ mol^{-1} and -756 kJ mol^{-1} respectively. What is the lattice energy of KBr likely to be?
- A -608 kJ mol^{-1}
 - B -652 kJ mol^{-1}
 - C -688 kJ mol^{-1}
 - D -788 kJ mol^{-1}

11.



The above diagram is a reaction profile of a two-step reaction.

What is the activation energy of the slow step?

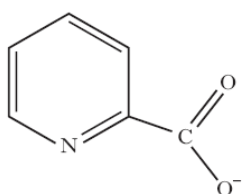
- A $+25 \text{ kJ mol}^{-1}$
 - B $+50 \text{ kJ mol}^{-1}$
 - C $+60 \text{ kJ mol}^{-1}$
 - D $+100 \text{ kJ mol}^{-1}$
12. Which of the following resultant solutions will have the lowest pH?
- A 15 cm^3 of $0.100 \text{ mol dm}^{-3}$ KOH added to 15 cm^3 of $0.050 \text{ mol dm}^{-3}$ benzoic acid
 - B 50 cm^3 of $0.050 \text{ mol dm}^{-3}$ KOH added to 25 cm^3 of $0.100 \text{ mol dm}^{-3}$ benzoic acid
 - C 25 cm^3 of $0.100 \text{ mol dm}^{-3}$ KOH added to 50 cm^3 of $0.100 \text{ mol dm}^{-3}$ benzoic acid
 - D 5 cm^3 of $0.100 \text{ mol dm}^{-3}$ KOH added to 50 cm^3 of $0.100 \text{ mol dm}^{-3}$ benzoic acid

13. In the dissociation of NH_4^+ to NH_3 and H^+ , $\Delta S^\ominus \approx -2.0 \text{ J K}^{-1} \text{ mol}^{-1}$.

In contrast, in the dissociation of ethanoic acid in water, $\Delta S^\ominus \approx -91.6 \text{ J K}^{-1} \text{ mol}^{-1}$.

The difference in entropy change of the two reactions is due to

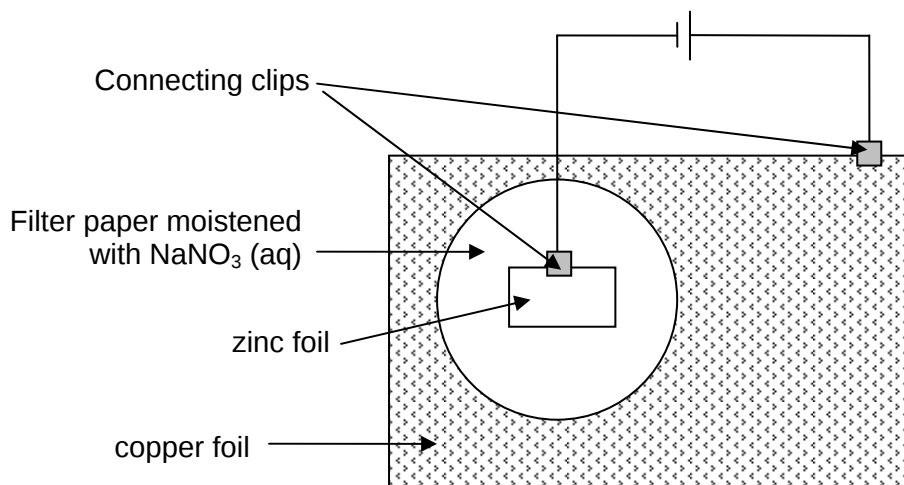
- A** an increased amount of water that is immobilised in the hydration spheres of H^+ and ethanoate ions formed in the dissociation of ethanoic acid.
- B** a faster rate of reaction between ethanoic acid and water.
- C** an increased mixing of particles in water during the dissociation of ethanoic acid and water.
- D** heat loss to surroundings during the dissociation of ethanoic acid and water.
14. Chromium picolinate $[\text{Cr}(\text{pic})_3]$ is a common dietary supplement taken by athletes. The structure of the picolinate ion, pic, is



The oxidation state of chromium in the complex is likely to be

- A** -3
- B** 0
- C** +3
- D** +6
15. The use of the Data Booklet is relevant to this question.

A current is passed through a simple cell as shown below:



What could be an expected observation?

- A** Sodium metal is deposited on the filter paper.
- B** The size of the zinc foil reduced with time.
- C** The filter paper turned blue.
- D** A brown gas is observed.

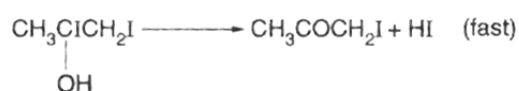
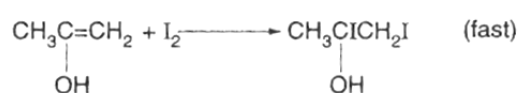
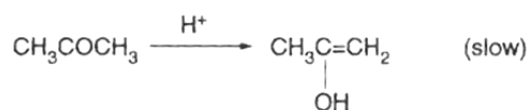
16. The use of the *Data Booklet* is relevant to this question.

The salt $\text{K}_3\text{Fe}(\text{CN})_6$ is prepared by oxidising $\text{K}_4\text{Fe}(\text{CN})_6$.

Which reagent can be used to carry out this oxidation?

- A H_2O_2 (aq)
- B Ag (s)
- C FeSO_4 (aq)
- D CuF_2 (aq)

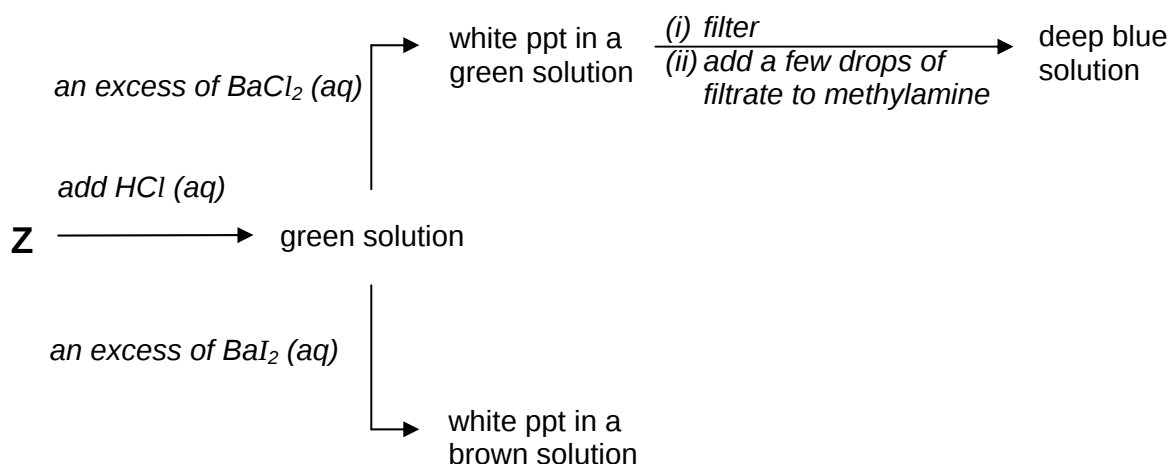
17. The mechanism of propanone with iodine in the presence of an acid is shown below:



Which statement is false?

- A Iodine is not involved in the rate-determining step.
 - B The acid acts as a catalyst.
 - C The rate of reaction is affected by temperature.
 - D The overall order of reaction is one.
18. Consider these Period 3 oxides Na_2O , SiO_2 and P_4O_{10} .
- Which factor decreases from Na_2O to SiO_2 and also from SiO_2 to P_4O_{10} ?
- A Solubility in aqueous alkali
 - B melting point
 - C pH when mixed with water
 - D Covalent character

19. Below is a scheme of reaction for a salt, **Z**.



What is **Z**?

- A copper(II) sulfate
- B copper(II) bromide
- C chromium(III) bromide
- D chromium(III) sulfate

20. When propene is heated with aqueous HBr, which of the following compound is a possible product?

- A

$$\begin{array}{c} \text{H} \quad \text{OHH} \\ | \quad | \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{H} \\ | \quad | \quad | \\ \text{H} \quad \text{H} \quad \text{H} \end{array}$$
- B

$$\begin{array}{c} \text{OHBr} \quad \text{H} \\ | \quad | \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{H} \\ | \quad | \quad | \\ \text{H} \quad \text{H} \quad \text{H} \end{array}$$
- C

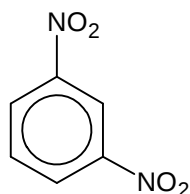
$$\begin{array}{c} \text{Br} \quad \text{Br} \quad \text{H} \\ | \quad | \quad | \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{H} \\ | \quad | \quad | \\ \text{H} \quad \text{H} \quad \text{H} \end{array}$$
- D

$$\begin{array}{c} \text{OHOHH} \\ | \quad | \quad | \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{H} \\ | \quad | \quad | \\ \text{H} \quad \text{H} \quad \text{H} \end{array}$$

21. The total possible number of structural isomers and stereoisomers of $\text{C}_3\text{H}_5\text{Br}$ that are non-cyclic is

- A 2
- B 3
- C 4
- D 5

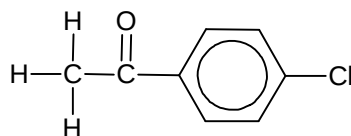
22. Chlorine gas was heated with 1,3-dinitrobenzene in the presence of iron (III) chloride.



The structure of the product of the reaction is

- A**
- B**
- C**
- D**

23. When compound **Z** is heated with iodine dissolved in aqueous KOH, what type of reaction is likely to occur?

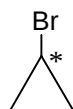


Compound **Z**

- A** Nucleophilic substitution
B Hydrolysis
C Elimination
D Oxidation

24. How can the rate of reaction between butanal and aqueous hydrogen cyanide be increased?
- A By adding a small amount of aqueous sodium cyanide.
 - B By irradiating the sample with UV light.
 - C By adding nickel catalyst.
 - D By adding concentrated sulphuric acid.

25. The structural formula of bromocyclopropane is



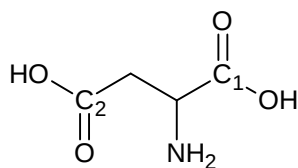
Which of the following statement about the carbon with an asterisk is true?

- A The C* is sp hybridised.
 - B The C* is sp² hybridised.
 - C The C* is sp³ hybridised.
 - D The C* is not hybridised.
26. A random enzymatic hydrolysis of an octapeptide yields the following fragments:
- Thr – Ser – Asn – Val
Pro – Val – Thr
Val – Pro
Asn – Val – Pro
Val – Pro – Gly

The sequence of amino acids in the molecule is likely to be

- A Asn – Val – Pro – Val – Thr – Ser – Asn – Val
 - B Pro – Val – Thr – Ser – Asn – Val – Pro – Gly
 - C Thr – Ser – Asn – Val – Pro – Gly – Val – Pro
 - D Val – Pro – Asn – Val – Pro – Val – Pro – Gly
27. Alanine is an amino acid with a methyl side chain.
- Arrange in increasing pH the following nitrogen compounds: alanine, 1-chloromethanamine, methanamine, ammonium chloride
- A ammonium chloride, 1-chloromethanamine, methanamine, alanine
 - B ammonium chloride, alanine, 1-chloromethanamine, methanamine
 - C alanine, ammonium chloride, methanamine, 1-chloromethanamine
 - D alanine, ammonium chloride, 1-chloromethanamine, methanamine

28. The pK_a values of C_1 carboxyl group, C_2 carboxyl group, and amino group of aspartic acid are 1.88, 3.65, and 9.60, respectively. Its structure is as shown below:



The predominant form of aspartic acid at pH 7 is

- A**
- B**
- C**
- D**

29. Which statement is **false** about an α -amino acid?

- A** It exists as a solid with high melting point.
B The amino group and carboxylic acid group are attached to the same carbon.
C They may exhibit optical isomerism.
D It can behave as a strong acid or base, and is thus amphoteric.

30. The presence of a quaternary structure in haemoglobin is confirmed by the presence of

- A** four subunits in a molecule of haemoglobin.
B ionisable amine groups on the side chain.
C interactions between the side chains about a polypeptide chain.
D an active site known as a heme group covalently bound to the protein.

SECTION B (10 MARKS)

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. 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

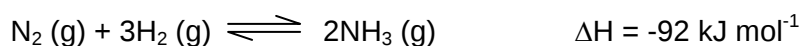
No other combination of statements is to be used as a correct response

- 31.** A proton, an electron, a neutron and a hydrogen radical are passed through an electric field.

What could be some possible observations?

- 1** The neutron is undeflected in the electric field.
- 2** The proton is deflected to a larger extent than the electron.
- 3** The hydrogen radical is deflected to the positive terminus.

- 32.** The Haber Process involves the following reaction between nitrogen and hydrogen gas:



Which of the following statement(s) about the Haber Process is / are true?

- 1** The percentage yield can be increased by increasing total pressure of the system.
- 2** The percentage yield can be increased by increasing temperature.
- 3** The reaction would have reached equilibrium when the equilibrium constant K is equal to 1.

- 33.** Based on the Bronsted-Lowry theory of acids and bases, which of the following is/are true about conjugate acids and conjugate bases?

- 1** An aqueous solution of $\text{C}_6\text{H}_5\text{O}^-\text{K}^+$ contains the conjugate base of phenol.
- 2** A conjugate acid of a weak base has a higher K_a than H_2O at room temperature and pressure.
- 3** Cl^- is the conjugate acid of HCl .

- 34.** Which of the following is able to react with chlorine?

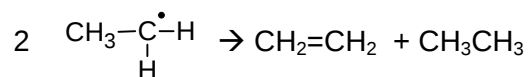
- 1** concentrated H_2SO_4 (aq)
- 2** NaBr (aq)
- 3** NaOH (aq)

35. Which of the following can react with aqueous sodium hydroxide?

- 1 COC/CH_3
- 2 $\text{CH}_3\text{OCOC}_6\text{H}_5$
- 3 $\text{C}_6\text{H}_5\text{CH}_2\text{OH}$

36. Ethane can undergo a series of reactions in limited amounts of chlorine gas and heat.

One reaction which may occur is shown below:



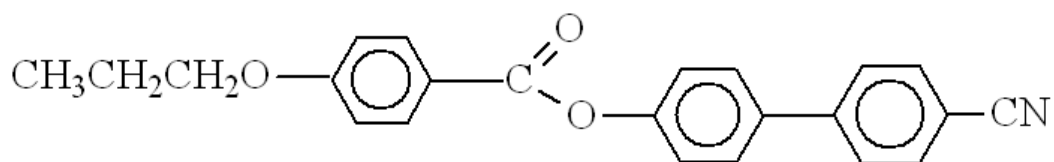
Which of the following statement(s) is / are true?

- 1 This reaction takes place in the termination step.
- 2 This is a disproportionation reaction.
- 3 This reaction is exothermic.

37. A compound with molecular formula $\text{C}_3\text{H}_6\text{O}$ may contain the following functional group(s):

- 1 an aldehyde
- 2 an alkene
- 3 an alcohol

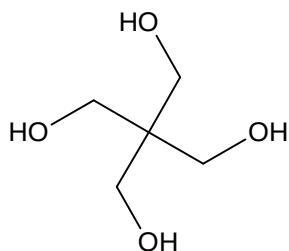
38. The following molecule



is able to react with the following reagent(s) at the stated conditions:

- 1 LiAlH_4 , room temperature
- 2 acidified aqueous KMnO_4 , reflux
- 3 2,4-dinitrophenylhydrazine, warm

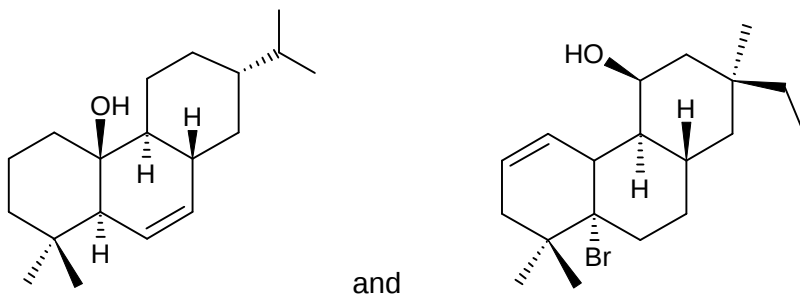
39. 2,2-bis(hydroxymethyl)propane-1,3-diol has a skeletal structure as shown below:



Which of the following about this compound is / are true?

- 1 It reacts with propanoyl chloride to form an ester.
- 2 It reacts with concentrated H_2SO_4 to form a substance that decolourises aqueous bromine.
- 3 It has an empirical formula CH_3O .

40. Which of the following reagents can be used to distinguish these two substances below?



- 1 acidified potassium manganate (VII)
- 2 acidified potassium dichromate
- 3 NaOH (aq), followed by HNO_3 (aq) and AgNO_3 (aq)

- End of paper-