



CATHOLIC JUNIOR COLLEGE
JC2 PRELIMINARY EXAMINATIONS
Higher 2

CHEMISTRY

9647/01

Paper 1 Multiple Choice

Wednesday 2 September 2015

1 hour

Additional Materials: Multiple Choice Answer Sheet
Data Booklet

READ THESE INSTRUCTIONS FIRST

Write your name and HT group on the Answer Sheet in the spaces provided.

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 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.

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

This document consists of **16** printed pages and **0** blank page.

[Turn over

Section A

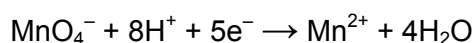
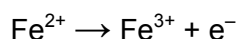
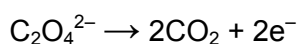
For each question there are **four** possible answers, **A**, **B**, **C** and **D**. Choose the one you consider to be **correct** and record your choice in soft pencil on the **separate Answer Sheet** provided.

- 1 When 20 cm³ of a gaseous hydrocarbon was completely burnt in 130 cm³ of oxygen, the volume of gas remaining after the reaction was 100 cm³. This volume was decreased to 40 cm³ when the resulting mixture was passed through aqueous sodium hydroxide. All measurements were made at room temperature and pressure.

What is the formula of this hydrocarbon?

- A** C₂H₂ **B** C₃H₆ **C** C₃H₈ **D** C₄H₁₀

- 2 Consider the following half-equations:



What volume of 0.01 mol dm⁻³ potassium manganate(VII) is required to oxidise completely 25.0 cm³ of an acidified solution of 0.01 mol dm⁻³ FeC₂O₄?

- A** 10 cm³ **B** 15 cm³ **C** 25 cm³ **D** 42 cm³

- 3 **X** and **Y** are elements with atomic numbers between 6 and 15.

Their first seven ionisation energies in kJ mol⁻¹ are shown below.

X	580	1800	2700	11600	14800	18400	23300
Y	1310	3400	5300	7500	11300	13300	71300

Which of the following best describes the compound formed between **X** and **Y**?

- A** basic
B acidic
C neutral
D amphoteric

4 Which pair of compounds fits the following descriptions?

- (i) The first compound has a larger bond angle about the central atom than the second compound **and**,
 (ii) The second compound is more polar than the first compound.

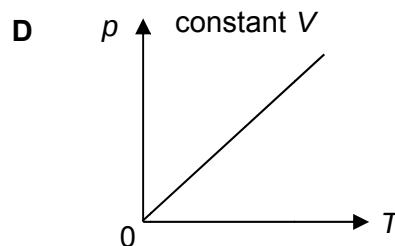
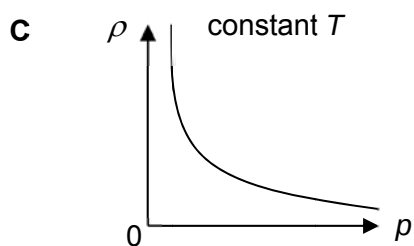
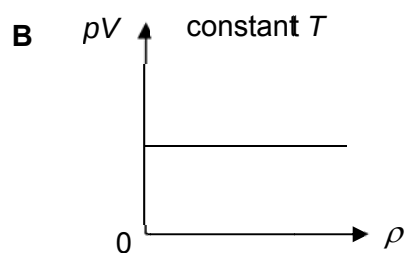
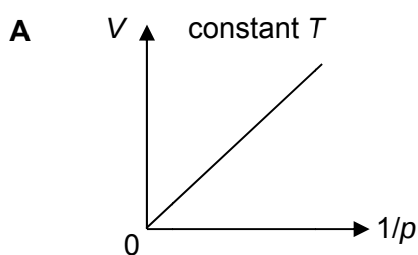
	first compound	second compound
A	BCl_3	SO_2
B	CF_4	XeF_4
C	HCN	BeCl_2
D	PH_3	NH_3

5 Which of the following statements regarding covalent compounds is true?

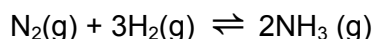
- A** Tetrachloromethane is a volatile liquid because the $\text{C}-\text{Cl}$ bond can be broken easily.
B CHCl_3 has a higher boiling point than CHF_3 because it has more electrons than CHF_3 .
C Hydrogen chloride is soluble in water because it can form permanent dipole-permanent dipole forces of attraction with water molecules.
D Each hydrogen bond formed between H_2O molecules is stronger than that formed between HF molecules.

6 Which of the following diagrams **does not** describe the behaviour of a fixed mass of an ideal gas?

(ρ = density of the gas, T = temperature measured in K)



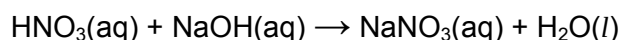
- 7 A nitrogen–hydrogen mixture, initially in the mole ratio of 1:3, reached equilibrium with ammonia when 50 % of the nitrogen had reacted. The total final pressure was p .



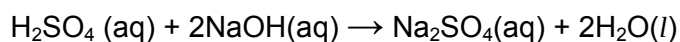
What was the partial pressure of ammonia in the equilibrium mixture?

- A** $\frac{p}{6}$ **B** $\frac{p}{4}$ **C** $\frac{p}{3}$ **D** $\frac{p}{2}$

- 8 The heat liberated in the neutralisation given below is -57 kJ mol^{-1} .



By using this information, what is the most likely value for the heat liberated in the following neutralisation?



- A** -57 kJ mol^{-1} **B** -86 kJ mol^{-1} **C** -114 kJ mol^{-1} **D** -228 kJ mol^{-1}
- 9 The value of ionic product K_w , at 35°C is 2.04×10^{-14} .
- What is correct for pure water at 35°C ?
- A** $\text{pH} < 7$
B $\text{pH} = 7$
C $[\text{H}^+] < [\text{OH}^-]$
D $[\text{OH}^-] = 1.02 \times 10^{-14} \text{ mol dm}^{-3}$
- 10 A solution of 20.0 cm^3 of 0.10 mol dm^{-3} sulfuric acid was titrated with 0.10 mol dm^{-3} ammonia.

Which statement regarding the titration is correct?

- A** The equivalence point is at $\text{pH} 7$.
B The initial pH of the solution is 1.
C 20.0 cm^3 of ammonia is required for titration for equivalence point to be reached.
D 80.0 cm^3 of ammonia is required for titration for maximum buffer capacity to be reached.

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

Soda is slightly acidic due to dissolved carbon dioxide.

By considering the relevant $E^\ominus$ values, which metal will **not** be dissolved by the soda?

- A V
- B Ag
- C Mg
- D Sn

- 12 15.7 g of the metal gadolinium (Gd) was deposited in electrolysis by a current of 5 A for 96.5 minutes. What is the formula of gadolinium ions?
[A_r of Gd = 157]

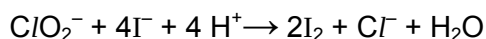
- A Gd^+
- B Gd^{2+}
- C Gd^{3+}
- D Gd^{4+}

- 13 Barium is the final product formed by a series of changes in which the rate-determining step is the radioactive decay of caesium-137. This radioactive decay is a first-order reaction with a half-life of 30 years.

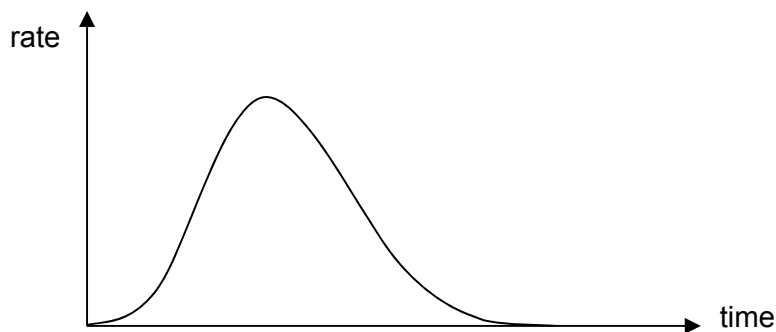
How long would it take for a rock sample, originally barium-free, to contain a molar proportion of caesium-137 to barium of 1:7?

- A 15 years
- B 30 years
- C 60 years
- D 90 years

- 14 The reaction between chlorite ions, ClO_2^- , and iodide ions, I^- , in acid solution may be represented by the following equation.

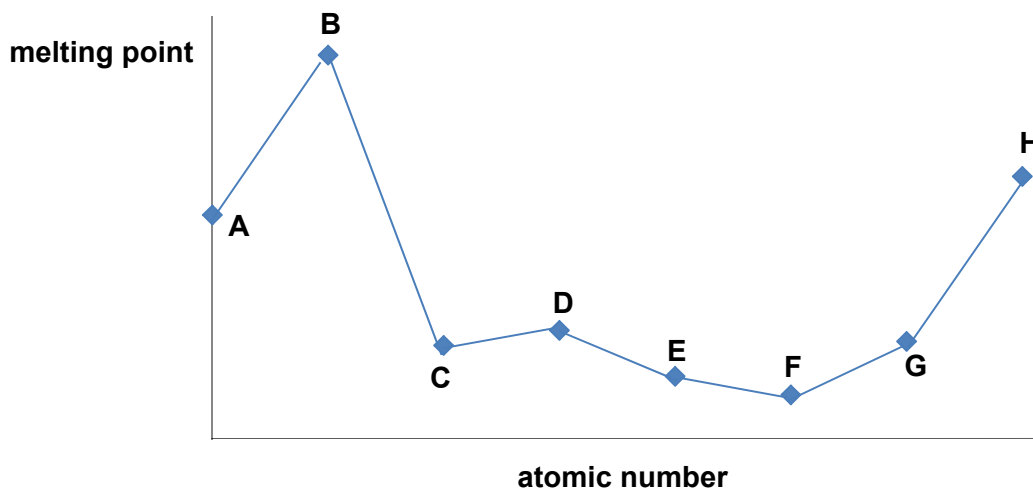


The rate-time graph for this reaction is as shown below.



What does the shape of the graph suggest about this reaction?

- A The reaction is endothermic.
 - B The reaction is overall first order.
 - C The reaction produces its own catalyst.
 - D The reaction rate is independent of iodide ions.
- 15 The graph below shows the variation in melting points for eight consecutive elements, A - H, in the Periodic Table, all with atomic number between 10 and 20.



What can be deduced from the graph?

- A The chloride of element C fumes in moist air.
- B Element F exists as a diatomic molecule.
- C The oxide of element B dissolves in water to give an acidic solution.
- D Element A has a higher first ionisation energy than the element preceding it.

16 Which of the following statements about the Group II elements (from Mg to Ba) or its compounds is **incorrect**?

- A** The ease of thermal decomposition of Group II nitrates decreases down the group.
- B** The reactivity of the elements with chlorine gas increases down the group.
- C** The melting point of the oxides increases down the group.
- D** The volume of gases formed per gram of carbonate decomposed decreases down the group.

17 Some properties of two salts, **M** and **N**, are given below.

When salt **M** was mixed with concentrated sulfuric acid, a colourless gas was produced. An aqueous solution of this colourless gas gave a white precipitate with silver nitrate. The precipitate readily dissolved in aqueous ammonia.

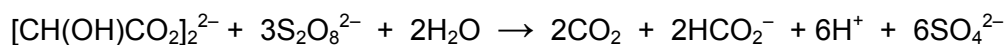
When salt **N** was heated with concentrated sulfuric acid, two gases were evolved. One gas has a red-brown colour while the other turned acidified potassium dichromate(VI) paper from orange to green.

Which of the following are possible identities of salt **M** and **N**?

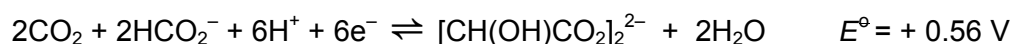
	salt M	salt N
A	NaCl	KBr
B	NaBr	KI
C	KI	NaBr
D	KCl	NaI

- 18 Use of the Data Booklet is relevant to this question.

Peroxodisulfate(VI), $\text{S}_2\text{O}_8^{2-}$, is capable of oxidising the tartrate ion, $[\text{CH}(\text{OH})\text{CO}_2]_2^{2-}$, to carbon dioxide and methanoate as shown in the following equation.

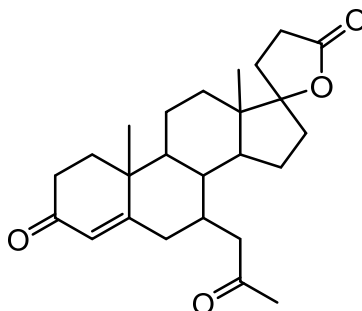


The reaction can be catalysed by a homogenous catalyst. Given that the standard electrode potential for the following half-equation is



Which metal ion can be a suitable catalyst for this reaction?

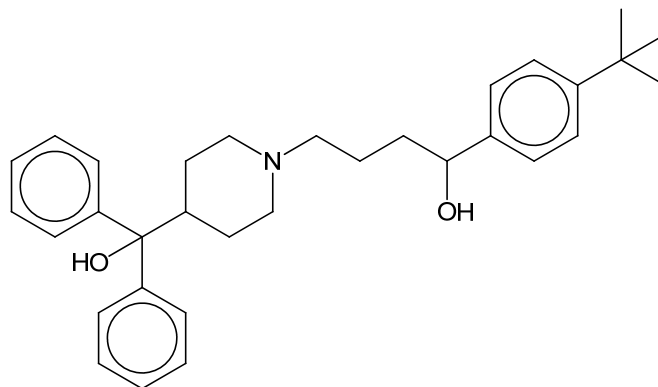
- A Cu^{2+}
 B Cr^{2+}
 C Mn^{2+}
 D V^{2+}
- 19 The diagram shows the structure of *Spironolactone*, which is an anti-androgen used in hormone therapy.



How many stereoisomers does *Spironolactone* have?

- A 2^3 B 2^4 C 2^6 D 2^7
- 20 What is the major product of the reaction between but-1-ene and gaseous DBr? (D = ^2H)
- A $\text{CH}_3\text{CH}_2\text{CH}(\text{OD})\text{CH}_2\text{Br}$ B $\text{CH}_2\text{DCHBrCH}_2\text{CH}_3$
 C $\text{CH}_2\text{BrCHDCH}_2\text{CH}_3$ D $\text{CH}_3\text{CHDCH}_2\text{CH}_2\text{Br}$

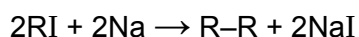
- 21 *Terfenadine* (sold under the trade name *Seldane*) alleviates seasickness and asthma in the same way as the older drugs, but it does not cause drowsiness as a side effect.



terfenadine

What deductions about *terfenadine* can be made from this structure?

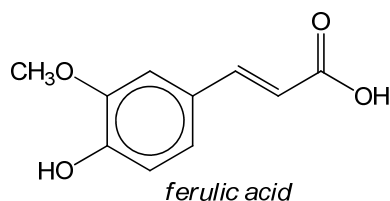
- A It is soluble in aqueous sodium hydroxide.
 - B It is chiral and contains a primary amine group.
 - C It can be oxidised to form a product which can react with ammoniacal silver nitrate solution.
 - D One mole of *terfenadine* will give out one mole of hydrogen on reaction with two moles of sodium.
- 22 An iodoalkane and sodium react when heated under reflux in an inert organic solvent to form an alkane according to the equation:



When a mixture of equal number of moles of the two different iodoalkanes, $\text{CH}_3\text{CH}_2\text{I}$ and $\text{CH}_3\text{CHICH}_3$, is used, which of the following alkanes will **not** be formed?

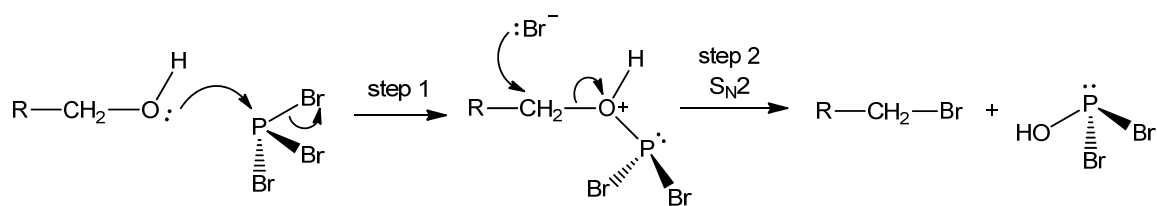
- | | |
|--|--|
| A $(\text{CH}_3)_2\text{CHCH}(\text{CH}_3)_2$ | B $\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)_2$ |
| C $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$ | D $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$ |

- 23 *Ferulic acid*, is an antioxidant that is reactive towards free radicals implicated in DNA damage, cancer and accelerated cell aging.



Assuming the $\text{CH}_3\text{O}-$ group is inert, which statement about *ferulic acid* is correct?

- A One mole of *ferulic acid* reacts with only one mole of bromine.
 B An ester is formed when *ferulic acid* is heated with propanoic acid in the presence of concentrated sulfuric acid.
 C One mole of *ferulic acid* reacts with only one mole of thionyl chloride.
 D *Ferulic acid* reacts with lithium aluminium hydride in dry ether to form a product that does not exhibit geometric isomerism.
- 24 Bromoalkanes are commonly prepared by reacting either a primary or secondary alcohol with phosphorus tribromide, PBr_3 . The reaction usually involves two steps, and the mechanism is shown below:

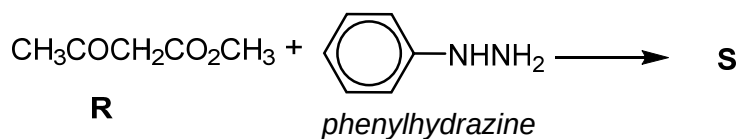


Which of the following statements regarding the reaction shown is correct?

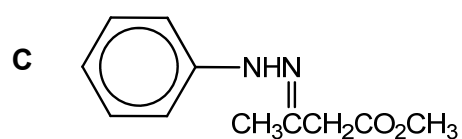
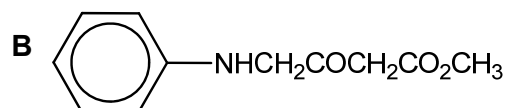
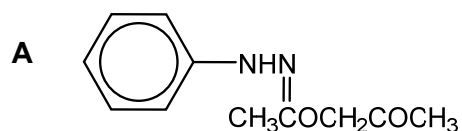
- A The rate of reaction for step 1 is independent of the concentration of the alcohol.
 B Both step 1 and step 2 involve the formation of a 5-coordinated transition state.
 C The reaction can be carried out in aqueous medium.
 D The alcohol acts as a nucleophile in step 1.
- 25 Which compound will **not** produce yellow precipitate on warming with alkaline aqueous iodine?

- A $\text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}_3$
 B $\text{ICH}_2\text{COCH}_2\text{CH}=\text{CH}_2$
 C $\text{CH}_3\text{CO}_2\text{CHI}_2$
 D I_3CCOCI_3

- 26 The reaction between compound **R** and phenylhydrazine gives rise to a precursor compound **S**, used in the formation of *Phenazone*, an anti-inflammatory drug.

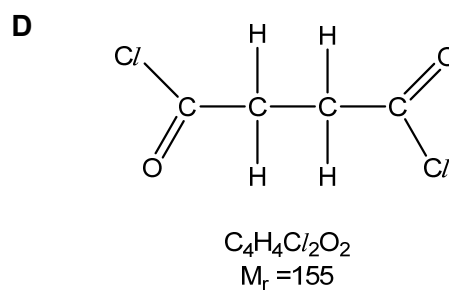
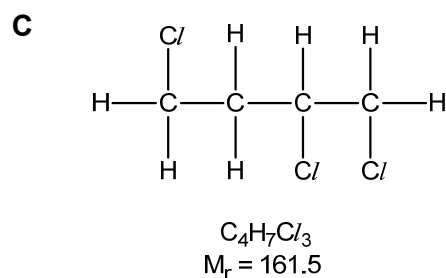
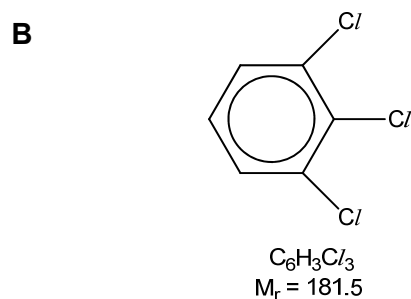
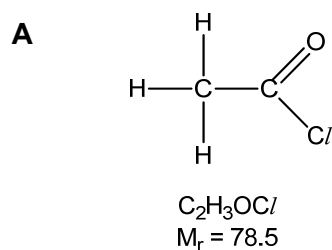


Which of the following is the correct structure of **S**?

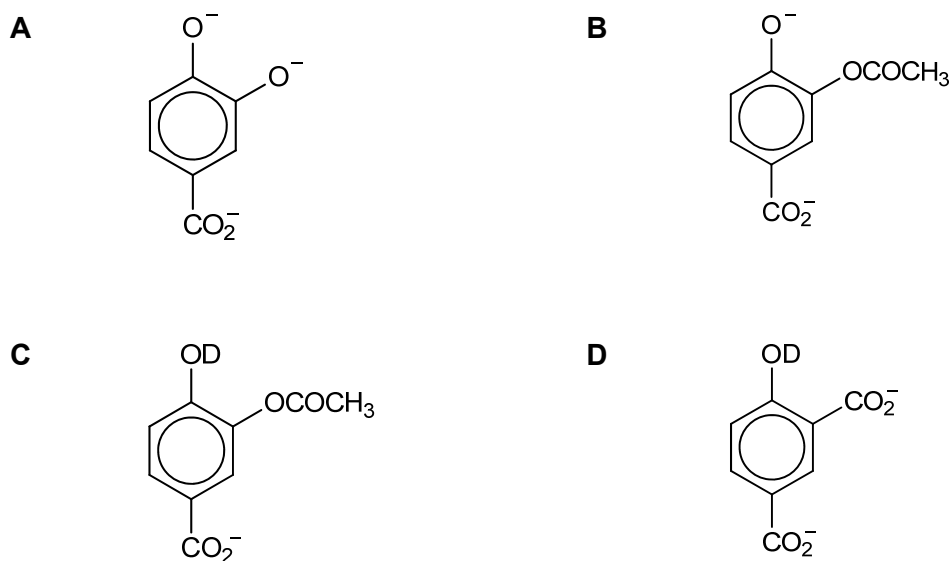
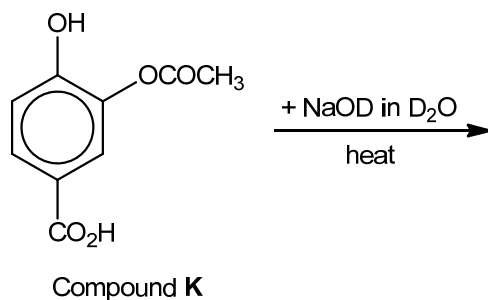


- 27 1 g of each of the following compounds was heated with NaOH(aq). After cooling, HNO₃(aq) was added followed by AgNO₃(aq).

Which compound will produce the largest mass of white precipitate?



- 28 Deuterium, D, is a heavier isotope of hydrogen. Which of the following shows the correct product when Compound **K** reacts as shown below?



- 29 Liquid **Q** is sparingly soluble in water but dissolves readily in cold sulfuric acid. 1 mol of **Q** reacts with 3 mol of $\text{Br}_2(\text{aq})$.

Which of the following is a possible identity of **Q**?

- A** $\text{C}_6\text{H}_5\text{CO}_2\text{H}$ **B** $\text{C}_6\text{H}_5\text{NH}_2$ **C** $\text{CH}_3(\text{CH}_2)_5\text{NH}_2$ **D** $\text{C}_6\text{H}_5\text{CH}=\text{CH}_2$

- 30 Consider the following compounds below:

- I** $\text{C}_6\text{H}_5\text{NH}_2$ **II** $\text{CH}_3\text{CH}_2\text{CONH}_2$ **III** $\text{CH}_3\text{CH}(\text{Cl})\text{NH}_2$ **IV** $\text{CH}_3\text{CH}_2\text{NH}_2$

Which of the following shows the correct order of decreasing $\text{p}K_b$ values for the above compounds?

- A** II, III, IV, I
B II, I, III, IV
C III, IV, I, II
D IV, III, I, II

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 the statements is or is not correct (you may find it helpful to put a tick against the statements that you consider to be correct).

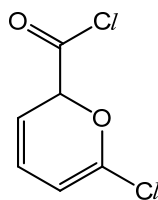
The responses **A** to **D** should be selected on the basis of

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.

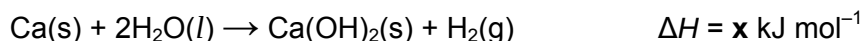
31 *Use of the Data Booklet is relevant to this question.*

Compound **L** ($M_r = 179$) has the structure as shown:



Which of the following statements about compound **L** are correct?

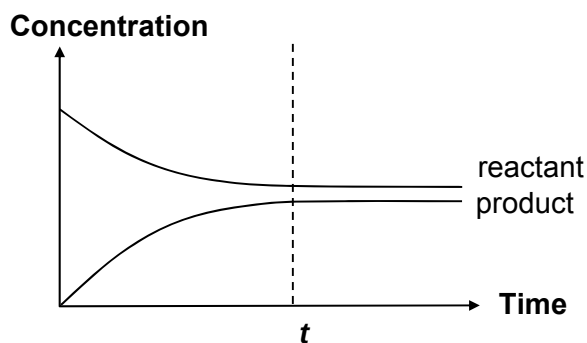
- 1** The empirical formula of **L** is C_3H_2ClO .
 - 2** 179 g of **L** requires 319.6 g of bromine dissolved in an inert organic solvent for complete reaction.
 - 3** Upon complete reaction with aqueous $AgNO_3$, 358 g of **L** forms 287 g of white precipitate.
- 32** The enthalpy change of reaction between calcium and water is measured in the laboratory and found to be $x \text{ kJ mol}^{-1}$.



What other information is needed to calculate the ΔH_f of $Ca(OH)_2(s)$?

- 1** enthalpy change of combustion of hydrogen
- 2** lattice energy of calcium hydroxide
- 3** enthalpy change of atomisation of calcium

- 33 The following graph is obtained from an experiment.



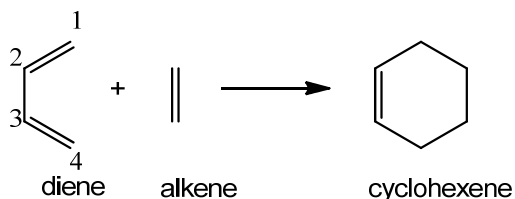
Which of the following are **not** correct statements about the reaction?

- 1 At time t , dynamic equilibrium is achieved.
 - 2 Addition of a catalyst increases the magnitude of t .
 - 3 Upon addition of a catalyst, at time t , the [product] to [reactant] ratio increases.
- 34 Which is **not** a trend from left to right across the elements of the third period of the Periodic Table?
- 1 melting points of the elements decrease steadily
 - 2 compounds of the elements change from ionic to covalent
 - 3 oxides of the elements change from basic to acidic.
- 35 During anodising of aluminium, 1 mol dm^{-3} aqueous H_2SO_4 is electrolysed between Al anode and graphite cathode, using a constant current for 60 s.

What affects the mass of oxide layer deposited on the Al anode?

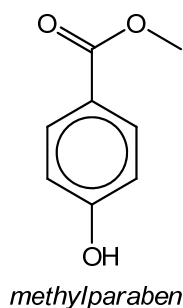
- 1 increasing the time taken
- 2 changing the electrolyte to 1 mol dm^{-3} aqueous HCl
- 3 increasing the concentration of the electrolyte solution

- 36** The Diels-Alder reaction is a cycloaddition that occurs between an “**electron-rich**” conjugated diene and “**electron-poor**” alkene, forming a cyclohexene ring.



Which of the following statements about this reaction are correct?

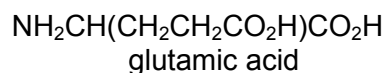
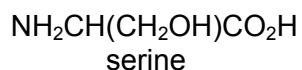
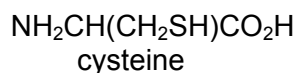
- 1** During the cycloaddition, carbons 1 and 4 of the diene and the two alkene carbons will change from being sp^2 hybridised to being sp^3 hybridised.
 - 2** The presence of a $-\text{CHO}$ substituent on the alkene molecule will increase the rate of the Diels-Alder reaction.
 - 3** The presence of a $-\text{CH}_3$ substituent on the diene molecule will increase the rate of the Diels-Alder reaction.
- 37** *Methylparaben* is an anti-fungal agent that is commonly used in a variety of cosmetic and personal care products.



Which deductions about the reactions of *methylparaben* can be made from its structure?

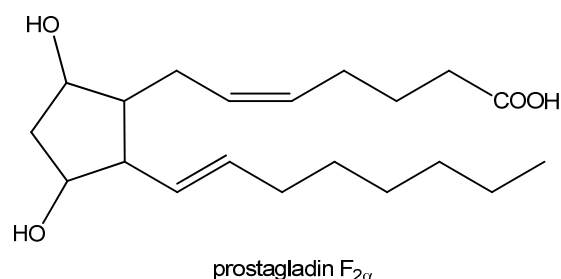
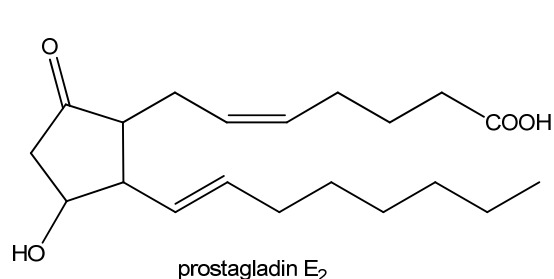
- 1** It can decolourise hot acidified KMnO_4 solution.
- 2** It can react with PCl_5 to form steamy fumes.
- 3** It can react with hydrogen cyanide in the presence of trace amount of NaCN .

- 38 Keratin is a fibrous and insoluble protein found in hair, nails and horns of mammals. It comprises mainly the three amino acids below:



Based on the above information, what type of bonding would stabilise the tertiary structure of keratin?

- 1 disulfide bonds
 - 2 hydrogen bonding
 - 3 van der Waals' forces
- 39 Prostaglandins are biomolecules with a wide range of biological effects which include lowering blood pressure and gastric secretion.



Which of the following statements correctly describe the two prostaglandin molecules shown above?

- 1 Both prostaglandin E₂ and F_{2α} are optically active molecules.
 - 2 Prostaglandin E₂ can be converted into prostaglandin F_{2α} by reacting with hydrogen in presence of nickel catalyst.
 - 3 Both prostaglandin molecules will form a silver mirror with Tollens' reagent.
- 40 Which of the following transformations involve a nucleophile?

