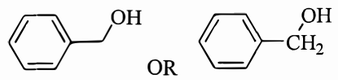
		Marks
3. (a) (i)	hydroxyl group	1
	aldehyde group	1
(ii)	(1) Test for aldehyde group or ketone group	1
	(2) 2,4-dinitrophenylhydrazine reacts with aldehyde or ketone to give yellow or red precipitate.	1
(iii)	hydroxyl group	1
(iv)	m/z = 91 suggested the presence of $C_7H_7^+$ ion.	1
	m/z = 108 suggested the presence of $C_7H_8O^+$ ion.	1
(v)	 OR	1
(b) (i)	Combustion of materials containing chlorine	1
(ii)	Dioxin is carcinogenic / can cause cancer.	1
(iii)	Gas chromatography-mass spectrometry	1
	It can measure more accurately the low level of dioxin than using gravimetric analysis or volumetric analysis.	1
(c) (i)	$AgNO_3(aq)$ and $NH_3(aq)$	2
(ii)	Step 1: Add excess $AgNO_3(aq)$ to the solution to form AgCl(s) and AgI(s).	1
	Step 2: Filter the mixture, wash with deionised water and dry the residue.	1
	Step 3: Determine the total mass of AgCl(s) and AgI(s) collected.	1
	Step 4: Wash the solid residue with excess ammonia solution to dissolve AgCl(s), filter and dry the residue, and determine the mass of AgI(s) remains.	1
(iii) •	Subtracting the total mass of AgCl(s) and AgI(s) determined in Step 3 by the mass of AgI(s) determined in Step 4 to get the mass of AgCl(s).	1
•	Number of mole of AgCl and AgI can be obtained by dividing their respective mass by the corresponding molar mass. Mole ratio of $Cl^-(aq)$ to $I^-(aq)$ can then be determined.	1

Candidates' Performance

Paper 1

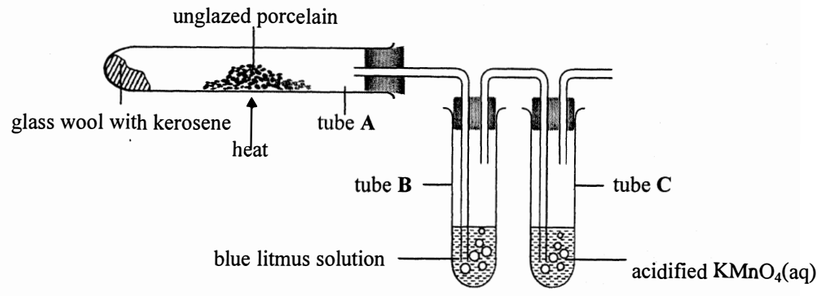
Paper 1 consisted of two sections, Section A (multiple-choice questions) and Section B (conventional questions). Sections A and B each comprised two parts, Part I and Part II. Part I contained questions set mainly on Topics I to VIII of the curriculum, while Part II mainly on Topics IX to XII. All questions in both sections were compulsory.

Section A (multiple-choice questions)

This section consisted of 36 multiple-choice questions. The mean score was 25. Candidates' performance was in general good. Some misconceptions of candidates were revealed from their performance in the following items.

1. For Q.17, some candidates did not realise a reaction would occur on porcelain surface. Moreover, they were not aware that vaporisation of kerosene rather than cracking occurs when the glass wool is heated. Some candidates did not know alkenes might be produced in tube **A** which could decolourise acidified $KMnO_4(aq)$ in tube **C**.

Q.17 The diagram below shows the set-up of an experiment :



The unglazed porcelain in tube **A** is strongly heated and the glass wool is occasionally heated. Which of the following statements is / are correct ?

(1) A chemical reaction occurs at the glass wool.
(2) There is NO colour change in the solution in tube **B**.
(3) There is NO colour change in the solution in tube **C**.

A.	(1) only	(22%)
B.*	(2) only	(50%)
C.	(1) and (3) only	(17%)
D.	(2) and (3) only	(11%)

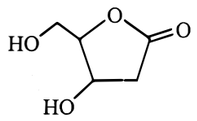
2. For Q.23, most candidates were able to decide that the second statement is a true statement. But some of them seemed to be unfamiliar with the properties of hexane and wrongly thought that hexane would have reaction with metals.

	1st statement	2nd statement
Q.23	When iron and copper are separately immersed in hexane completely, iron corrodes faster than copper.	Iron can be oxidised more readily than copper.

A.	Both statements are true and the 2nd statement is a correct explanation of the 1st statement.	(36%)
B.	Both statements are true but the 2nd statement is NOT a correct explanation of the 1st statement.	(7%)
C.*	The 1st statement is false but the 2nd statement is true.	(49%)
D.	Both statements are false.	(8%)

3. For Q.28, many candidates showed difficulties in examining the structure of a cyclic organic compound. They were not able to recognise the presence of an ester group and wrongly pointed out that the compound contains a ketone group. They were also not able to identify chiral carbons in the cyclic organic compound. Lastly, some candidates got an incorrect number of hydrogen atoms in the molecule.

Q.28 The structure of an organic compound is shown below :



Which of the following statements is correct ?

A.	The compound does NOT show enantiomerism.	(16%)
B.	The molecular formula of the compound is $C_5H_6O_4$.	(13%)
C.	The compound contains a ketone group.	(24%)
D.*	The compound can be oxidised by acidified $K_2Cr_2O_7$(aq).	(47%)

Section B (conventional questions)

Question Number	Performance in General
Part I	
1	Satisfactory
2	Good
3	Good
4	Fair
5	Fair
6	Satisfactory
7	Fair
8	Fair
9	Good
10	Satisfactory
Part II	
11	Good
12	Satisfactory
13	Poor
14	Satisfactory
15	Poor
16	Satisfactory

1. (a) Fairly answered. Although the majority of candidates were able to state that the isotopes of an element have the same number of protons but different number of neutrons, many failed to mention '*isotopes are atoms of an element ... ...*' in their answer.

(b) Well answered. The majority of candidates were able to perform the calculation correctly. However, some candidates gave an inappropriate unit to the answer (e.g., g mol^{-1}).

(c) Fairly answered. Many candidates wrongly wrote that neon is used in light bulbs or potato chips packages. Some candidates gave vague answers such as '*for making advertising boards*'.

(d) Fairly answered. Many candidates were able to recognise that oxygen consists of diatomic molecules while Ne is monoatomic. However, quite a number of them did not point out the stronger van der Waals' forces between O_2 molecules are due to their larger molecular size in comparison with that of Ne atoms. Some candidates also wrongly answered that a large amount of energy is required to break the strong covalent bonds of the O_2 molecules when oxygen boils.

2. (a) (i) Well answered. The majority of candidates were able to give the answer with correct spelling.

(ii) Satisfactorily answered. However, many candidates were not able to explain the importance of cracking processes in industry according to their abilities of producing '*more*' useful alkenes or alkanes with lower molecular masses.

(b) Well answered.

(c) (i) Well answered.

(ii) Satisfactorily answered. However, some candidates were not able to give a complete description for the expected colour change in the chemical test. Some candidates did not mention the expected observation for the compound giving a negative result in the test.

3. (a) Well answered. However, some candidates wrongly mentioned that the lemon functions as a salt bridge which allows electrons to pass through.

(b) Satisfactorily answered. However, some candidates confused '*reducing power*' with '*oxidising power*', and arranged the species in the reversed order.

(c) (i) Well answered.

(ii) Poorly answered. The majority of candidates were not able to write the half equation for the change that occurs at copper strip, and wrongly wrote that $Cu^{2+}(aq)$ is reduced to Cu(s).

(d) Well answered. Most candidates were able to mention that silver occupies a lower position in the E.C.S. than copper.

4. Fairly answered. Many candidates were able to give a correct drawing to illustrate the hydrogen bonding in HF. However, many of them only pointed out that 'F is electronegative' or 'F is more electronegative than H', but failed to state that 'F is a highly electronegative element' or 'the covalent bond between H and F is very polar'.

5. (a) Fairly answered. Many candidates wrongly considered that the error is due to the dilution caused by the water of crystallisation in the copper(II) sulphate crystals. Moreover, quite a number of them wrongly put '$CuSO_4 \cdot 5H_2O$' in the chemical equation. Lastly, many candidates wrongly wrote '*Fe displaces Cu*' instead of '*Fe displaces* Cu^{2+}'.

(b) (i) Poorly answered. Most of the candidates were not able to explain the formation of Cu in terms of '*preferential discharge of* Cu^{2+} *ions*'.

(ii) Poorly answered. Very few candidates clearly described that the formation of H_2 bubbles hindered the coating of Cu on the metallic object.

(c) Well answered.

6. Satisfactorily answered. However, some candidates missed the crucial step of dissolving $Pb(NO_3)_2(s)$ in water. Moreover, many candidates wrongly treated $PbSO_4(s)$ as a soluble salt. A few candidates misinterpreted the question as the preparation of $Pb(NO_3)_2(s)$ from $PbSO_4(s)$.

7. (a) Generally well answered. However, some candidates gave a complete equation instead of an ionic equation.

(b) Well answered.

(c) Poorly answered. Only a few candidates recognised that the function of the inverted funnel is to prevent sucking back when a very soluble gas (e.g. NH_3) is dissolved. Most candidates wrongly suggested the function of the inverted funnel was to prevent the ammonia from escaping to the surrounding by providing a larger surface area for dissolution.

(d) (i) Well answered.

(ii) Fairly answered. Many candidates wrongly answered 'red to yellow', where the titration is over-shot when using methyl orange as indicator.

(iii) Poorly answered. Only a few candidates were able to perform the calculation. Most candidates failed to recognise which compounds are involved in each step of the experiment. They were not able to demonstrate a good mastery of chemical stoichiometry.

(e) Well answered.

8. (a) Satisfactorily answered. Many candidates were able to answer that $KHCO_3$ is a bread-raising agent, which can make the bread soft and spongy. However, some of them failed to mention that the bread-raising process is due to the formation of CO_2 from the thermal decomposition of $KHCO_3$.

(b) Well answered.

(c) (i) Poorly answered. Many candidates were not able to recognise that reaction (1) is endothermic. They also omitted the '+' sign in the answer. Some candidates used a wrong mass of the reacting mixture in their calculation.

(ii) Poorly answered. Many candidates were not able to recognise the relation between the enthalpy changes of Reaction (1) and Reaction (2). Many candidates did not express the enthalpy change of decomposition as per mole of $KHCO_3$.

(d) (i) Poorly answered. Many candidates were not able to construct an enthalpy change cycle based on Hess's law for the calculation.

(ii) Well answered.

9. (a) Generally well answered. Some candidates were not able to give the correct colour of the gel before rusting occurs. They also wrongly mentioned that the indicator would turn reddish-brown upon rusting of the iron nail.

(b) Well answered. However, some candidates wrongly wrote '*magnesium is preferentially discharged*'.

10. Generally well answered. Some candidates wrongly suggested measures which are not related to fossil fuel usage (e.g. using nuclear energy). Some candidates gave answers that do not match with the suggested applications, such as installing scrubbers in vehicles or installing catalytic converters in factories.

11. (a) Well answered. A few candidates gave a wrong unit in the answer.

(b) Generally satisfactorily answered. Many candidates correctly stated that hydrochloric acid is a monobasic acid and sulphuric acid is a dibasic acid. However, many of them did not know that 2.0 M H_2SO_4 has a higher concentration of $H^+(aq)$ than 2.0M HCl(aq). They were not able to state that the increase in initial rate is due to an increase in the concentration of $H^+(aq)$.

(c) Well answered.

12. (a) Well answered.

(b) Generally satisfactorily answered. Some candidates were not able to mention that both ethyl ethanoate and cinnamaldehyde are non-polar, so they are attracted to each other by weak intermolecular forces.

(c) Generally well answered. Some candidates mistook that the drawing of set-up for fractional distillation is required. Moreover, common mistakes were found in the drawings including wrong position of the thermometer and set-up of a closed system.

(d) Generally well answered. Many candidates were able to produce a reasonable scheme for the synthesis. Common mistakes include omitting H^+ and / or heating when using $K_2Cr_2O_7$ as oxidising agent, and confusing reducing agents with oxidising agents (e.g. using $LiAlH_4$ to carry out oxidation).

13. (a) Poorly answered. Very few candidates were able to calculate the concentration of the reacting species (in particular, the concentration of Fe^{3+}) in the reaction mixture right after mixing.

(b) Well answered.

14. (a) (i) Generally satisfactorily answered. However, some candidates were not able to identify the chiral carbon. Many candidates wrongly mentioned that compound **Y** also has a chiral carbon.

(ii) Generally satisfactorily answered. However, some candidates were not able to state clearly that **X** is optical active while **Y** is not as **X** has a chiral carbon but **Y** does not.

(b) Generally well answered. However, many candidates were not able to point out that a detergent molecule consists of an ionic 'head' and a hydrocarbon 'tail'. Moreover, some of them mis-spelt the words 'hydrophilic' and 'hydrophobic'.

15. Poorly answered. Many candidates did not state clearly the steps involved in the formation of CH_3Br from CH_4 and Br_2. Many of them omitted some electrons in their drawings, especially the lone-pairs of electrons.

16. (a) Well answered. However, a few candidates wrongly included SiO_2 in their answers.

(b) Satisfactorily answered. Some candidates wrongly considered that SiO_2 exists as molecules.

(c) Poorly answered.

Paper 2

Paper 2 consisted of three sections. Section A contained questions set on Topic XIII 'Industrial Chemistry', Section B on Topic XIV 'Materials Chemistry' and Section C on Topic XV 'Analytical Chemistry'. Candidates were required to attempt all questions in two of the sections.

Question Number			Popularity / %	Performance in General
1	(a)	(i)	48	Good
		(ii)		Fair
		(iii)		Fair
		(iv)		Poor
	(b)	(i)		Satisfactory
		(ii)		Satisfactory
		(iii)		Poor
	(c)	(i)		Poor
		(ii)		Good
		(iii)		Satisfactory
2	(a)	(i)	5	Fair
		(ii)		Fair
		(iii)		Poor
	(b)	(i)		Fair
		(ii)		Fair
	(c)	(i)		Satisfactory
		(ii)		Fair
3	(a)	(i)	47	Good
		(ii)		Good
		(iii)		Good
		(iv)		Fair
		(v)		Fair
	(b)	(i)		Poor
		(ii)		Poor
		(iii)		Poor
	(c)	(i)		Satisfactory
		(ii)		Satisfactory
		(iii)		Satisfactory

Section A

1. (a) (i) Well answered. However, some candidates erroneously stated platinum as the catalyst, and many of them were not able to provide sufficient explanations such as 'a positive catalyst is related to an alternative pathway with lower activation energy'.

(ii) Fairly answered. Only a few candidates were able to correctly suggest steam reforming of natural gas as the process for providing the hydrogen required. Many candidates suggested 'electrolysis of sea water', 'adding metal like sodium to acid', 'fractional distillation of liquid air', or 'the reverse reaction of Haber process', which were not feasible in industry.

(iii) Fairly answered. General speaking, many candidates showed good understanding that high temperature would increase the reaction rate and high pressure is not preferred in this reaction. However, only some of them explained the use of only 200 atm pressure relates to the high cost in construction of reaction chamber, pipelines, etc. Instead, they just stated 'high pressure is expensive'. Also, only a few candidates explained the use of only 200 atm pressure is due to safety. Many candidates were not able to explain the two reaction conditions separately. Wrong answers like 'high temperature and lower pressure can increase the reaction rate' were common.

(iv) Poorly answered. Many candidates confused the two ideas 'removal of product mixture' with 'removal of product (ammonia)', and hence they wrongly used equilibrium shift to explain the practice.

(b) (i) Satisfactorily answered. Many candidates were able to suggest an industrial use of methanol (e.g. making ethanoic acid), but quite a lot of candidates incorrectly suggested that methanol can be used as a fuel, a material for making wine or a food additive.

(ii) Satisfactorily answered.

(iii) Poorly answered. Many candidates just raised a few general principles of green chemistry, without making reference to the methanol production technology as required from the question.

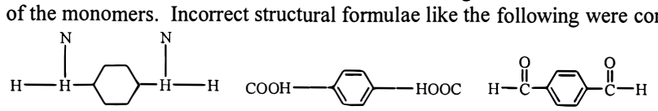
(c) (i) Poorly answered. Many candidates were not able to make use of the given information in answering the question.

(ii) Well answered. Most candidates were able to deduce the reaction orders. However, some candidates did not show a correct deduction.

(iii) Satisfactorily answered. Some candidates were not familiar with rate equation, and hence many of them mistakenly wrote answers like 'initial rate = k $[NO]^2$ $[H_2]$' or 'rate equation = k $[NO]$ $[H_2]$'. A significant number of candidates were not able to complete the calculation. Many candidates confused 'rate constant k' with 'equilibrium constant K'. Incorrect units were commonly presented after calculation.

Section B

2. (a) (i) Fairly answered. Many candidates were not able to give the correct structural formulae of the monomers. Incorrect structural formulae like the following were common:



In addition, many of them were not able to distinguish between condensation polymerisation and addition polymerisation.

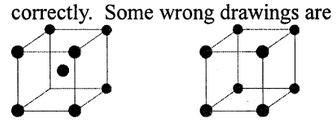
(ii) Fairly answered. Many candidates failed to make a good comparison in part (2).

2. (a) (iii) Poorly answered. Many candidates explained the difference only in terms of intermolecular interactions, but ignored the structural features of the two polymers.

(b) (i) Fairly answered. Many candidates were not able to present all the properties of vulcanised rubber, i.e. rigid with some flexibility. In addition, some candidates did not have a good understanding of vulcanisation.

(ii) Fairly answered.

(c) (i) Satisfactorily answered. Some candidates were not able to draw the unit cell of iron correctly. Some wrong drawings are shown below:



Some candidates erroneously calculated the number of iron atoms in a unit cell as ¼ × 8 + 1 = 3. Some candidates correctly calculated the number of iron atoms in a unit cell. However, they failed to present the deduction process.

(ii) Fairly answered. Many candidates were not able to suggest the elements other than iron found in stainless steel, and hence failed to explain the properties of stainless steel.

Section C

3. (a) (i) Well answered. However, some candidates wrongly used the following terms interchangeably.
- 'hydroxy group', 'alcohol' and 'alkanol'
- 'carbonyl group', 'aldehyde' and 'alkanal'

(ii) Well answered. Some candidates wrongly wrote 'keytone' instead of 'ketone', and some just stated the colour 'orange' as the observation.

(iii) Well answered.

(iv) Fairly answered. Many candidates failed to put a positive charge onto the chemical species with m/z=108 and 91.

(v) Fairly answered.

(b) (i) Poorly answered. Most candidates incorrectly correlated the presence of dioxins in the air to the burning of fossil fuels, and/or to chemicals released from furniture.

(ii) Poorly answered.

(iii) Poorly answered. Many candidates arbitrarily wrote the names of a number of instruments like colorimeter and air monitoring machines; some used loose terms like computer and machine.

(c) (i) Satisfactorily answered. However, some candidates wrongly suggested starch and iodine to be the reagents required.

(ii) Satisfactorily answered. About half of the candidates were able to present the essential experimental steps systematically.

(iii) Satisfactorily answered.

General comments and recommendations

1 Candidates were generally weak in answering questions involving calculation and data analysis. These include mass/mole/concentration calculations for a titration experiment, calculation of the enthalpy changes of reactions, and calculations on chemical equilibrium.

2. Many candidates were weak in redox chemistry. They were confused about the concepts of oxidation, reduction, oxidation power, reducing power, position of chemical species in the electrochemical series, and chemical reactions that occur at the electrodes.

3. Many candidates were not able to state the expected colour changes/observations in chemical tests, or the difference in results of positive and negative tests.

4. Many candidates confused the types of chemical bonding with intermolecular forces in different types of chemical species.

School-based Assessment

All school candidates have to participate in School-based Assessment (SBA). There were 17105 students from 441 schools submitted their SBA marks this year. Despite this being the first year of implementation of School-based Assessment (SBA) for the Hong Kong Diploma of Secondary Education (HKDSE), the implementation was generally satisfactory in most of the participating schools. This is probably attributed to the fact that many teachers have a lot of experience in the Teaching Assessment Scheme (TAS) of the Hong Kong Advanced Level Examination (HKALE).

To ensure that teachers have a good understanding of the requirements and the principles of the assessment methods of the SBA, SBA annual conferences were held in October of each school year, and mid-year district group meetings were organised. These meetings provided opportunities for in-depth discussion and experience sharing. Furthermore, the Curriculum Development Institute of the Education Bureau and the Hong Kong Examinations and Assessment Authority collaboratively provided training courses and useful resources for new teachers, and helped them to gain confidence in implementing SBA in their classes.

Based on the assessment data and samples of students' worksheets and reports submitted by participating schools, students' performance was in general satisfactory and within the expectations of the assessment requirements. To address the potential discrepancies in the marking standard among individual teachers and schools, mark moderation based on both statistical methods and professional judgment was performed. We are happy to report that 63.5% of schools fall into the 'within the expected range' category, while the marks of 20.6% of schools are higher than expected, and 15.9% lower than expected. However, among the schools with marks higher or lower than expected, the majority only deviate slightly from the expected range. This is encouraging as the data show that the majority of the teachers have a good understanding of SBA implementation, and hence the marking standards are generally appropriate.

To provide continuing support for teachers and to ensure fair implementation of the SBA, two supervisors are assigned to supervise all the schools, and there is a total 24 district coordinators to address enquiries from teachers about SBA implementation, and to ensure that schools are running the scheme within the stipulated guidelines. Phone calls, email correspondences and school visits were conducted to establish close connections between the district coordinators and the teachers. Based on the feedback from various sources, both teachers and students understand the essence and the requirements of the SBA. Nonetheless, some comments and recommendations are given below so that further improvement on the implementation of SBA could be made:

1. Variety of Experiments
   It is appropriate to allow students to carry out assessment task involving volumetric work (such as determination of SO_2 content in a red wine sample), and classified it as 'other experiment'. It is also understandable that performing this type of assessment task can help students to develop an in-depth understanding of volumetric analysis, including sample treatment, preparation of a standard solution, data analysis, etc. However, with a view to using a variety of experiments for assessment, it is recommended that teachers make reference to the suggested practical activities in the curriculum and assessment guide, and allow students to do various types of experiments.

2. Variety of Written Work
   Worksheets, quizzes and brief / detailed laboratory reports, etc. are all acceptable formats of written work. Teachers generally designed these tasks in a professional manner. Moreover, it is encouraging that most students can follow the instructions given by teachers in accomplishing the written work. Although there is no stipulated requirements in the SBA guidelines regarding the types of written reports to be submitted by a student, writing laboratory reports is definitely an important part of the training for students studying experimental sciences. Organising a laboratory report in the correct format and presenting the data and experimental findings properly are very important. Previous experience showed that students frequently omitted some essential items (such as date, experimental title, objectives, and reference, etc) in the first few times when they wrote laboratory reports. However, after gaining some experience, students were able to write a laboratory report in a proper manner.

3. Use of 'feedback' to promote learning
   Providing feedback to students' submitted reports is important for facilitating students' improvement, as it helps students to avoid making the same type of mistakes in the future. Moreover, students are encouraged to

discuss with their teachers to understand their own performance in carrying out experiments and finishing the related written tasks.

Conclusion

Although this is the first implementation of SBA in the HKDSE, the students' performance in general is quite satisfactory, and teachers also managed to run the SBA smoothly in their lessons. The experience accumulated in the TAS of HKALE has greatly facilitated the implementation of SBA in the HKDSE. With the experience acquired in this cohort, any queries and challenges that teachers and students have encountered will be further addressed in subsequent years.