SUGGESTED ANSWERS

Paper 1

Section A

Question No.	Key	Question No.	Key
1.	B	19.	D
2.	A	20.	C
3.	B	21.	D
4.	C	22.	D
5.	D	23.	A
6.	C	24.	C
7.	A	25.	A
8.	D	26.	C
9.	B	27.	B
10.	D	28.	C
11.	C	29.	C
12.	B	30.	A
13.	C	31.	C
14.	B	32.	B
15.	A	33.	C
16.	A	34.	D
17.	A	35.	B
18.	C	36.	C

Section B

PART I

Marks

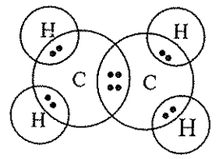
1. (a) False. The high melting point of NaCl is due to the strong electrostatic attraction between (sodium ions and chloride) ions / the presence of strong ionic bonds. The low melting point of CH_4 is not due to the existence of covalent bonding between C and H atoms but due to the weak van der Waals' forces between the molecules/weak intermolecular forces. — 1, 1

(b) False. Dilution of concentrated H_2SO_4 is a highly exothermic process. The heat evolved may cause the acid to splash out. — 1, 1

(c) False. 'A is a stronger acid than B' only means the degree of ionization of A is larger than that of B. However, the pH of an acid solution depends on both the degree of ionisation and its concentration. As such, the stronger acid A may have a higher pH than the weaker acid B if the concentration of acid B is higher than that of A by an adequate amount. — 1, 1

6

2. (a)



1

(b) †addition (polymerisation) — 1

(c) durable / water repelling / chemically inert / high tensile strength — 1

(d) (i) Incineration — 1

(ii) Advantage: can reduce the volume of solid waste / converts plastic wastes into energy — 1

Disadvantage: releases toxic gases (CO / dioxin) / CO_2, which is a greenhouse gas / particulates which cause respiratory diseases (darkening of buildings) / cost to remove air pollutant from flue gas is high — 1

or (i) Landfilling — (1)

(ii) Advantage : does not cause much air pollution / produces methane which is a fuel — (1)

Disadvantage : a lot of landfill sites are required / causes underground water pollution — (1)

or (i) Recycling — (1)

(ii) Advantage : saves petroleum which is a non-renewable energy source / reduces the volume of solid waste / does not cause much air pollution / can help to conserve plastic materials — (1)

Disadvantage : difficult to separate PE from other wastes / recycling is energy consuming — (1)

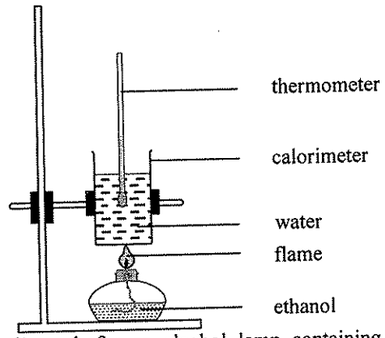
(Accept reasonable answers.)

6

† Correct spelling

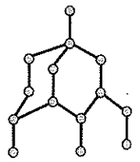
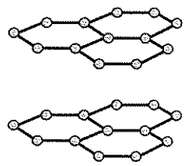
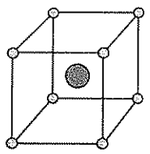
			Marks
3.	(a)	Hydrogen / H_2	1
		It burns with a 'pop' sound.	1
	(b)	†redox / reduction-oxidation reaction	1
	(c)	Reactivity: $Z < Y < X$	1
		Y is more reactive than Z as Y can displace Cu from $CuSO_4(aq)$ but Z cannot.	1
		X is more reactive than Y as X can react with cold water but Y cannot / oxide of X cannot be reduced by carbon but oxide of Y can.	1
	(d)	X is a reactive metal.	1
		It reacts with water in the copper(II) sulphate solution and the colourless gas liberated is hydrogen.	
			7
4.	(a) (i)	purple / blue	1
		H^+ is discharged at carbon rod A (cathode)	
		$2H^+ + 2e^- \rightarrow H_2$	1
		$\therefore$ OH^- concentration increases around carbon rod A / concentration of $OH^-(aq)$ is higher than that of $H^+(aq)$.	1
	(ii)	oxygen	1
		OH^- is discharged at carbon rod B (anode)	1
		$4OH^- \rightarrow O_2 + 2H_2O + 4e^-$	(1)
	(b)	pencils / zinc-carbon cells	1
			6

† Correct spelling

			Marks
5.	(a)		2
		(1 mark for an alcohol lamp containing some ethanol; 1 mark for a calorimeter containing some water.)	
	(b)	Heat released = $200 \times 4.2 \times 6$	
		$= 5040$ J (or 5.04 kJ)	1
		No. of moles of $C_2H_5OH(l)$ burnt = $\dfrac{0.185}{(12.0\times2+1.0\times6+16.0)}$	
		$= 4.02 \times 10^{-3}$	1
		Enthalpy change of combustion of $C_2H_5OH(l)$	
		$= -\dfrac{5.04}{4.02\times10^{-3}}$	
		$= -1254$ kJ mol^{-1}	1
	(c)	No heat loss to the surroundings The ethanol undergoes complete combustion } any one	1
			6
6	(a)	The structure of water is non-linear (or in drawing)	1
		The dipole moments on the two O–H bonds cannot cancel each other / water has a net dipole moment / is a polar molecule $\therefore$ would be attracted by the electric field.	1
	(b)	The water jet will be attracted towards the rod.	1
		Water molecules will orientate themselves in alignment with the electric field so that they will be attracted.	1
		(Accept equivalent answers.)	
	(c)	The liquid jet is attracted by the electric field. In the presence of an electric field, a dipole moment will be induced in the hexane molecule.	2
		or,	
		The jet is not attracted. Only a weak dipole moment is induced in hexane molecules. The attraction between the induced dipole and the electric field is not strong enough to cause a deflection of the liquid jet.	(2)
			6

Marks

7.

Solid substance	Three-dimensional diagram for the structure of the solid substance	Explanation of whether the solid substance is an electrical conductor	
diamond		Insulator because no mobile electrons	1+1
graphite		Conductor because mobile / delocalized electrons are present	1+1
caesium chloride		Insulator because no mobile ions	1+1

6

8. (a) Zinc granules dissolve / a (colourless) gas is produced / solution gets warm 1

$Zn + 2HCl \rightarrow ZnCl_2 + H_2$ 1

or $Zn + 2H^+ \rightarrow Zn^{2+} + H_2$ (1)

(b) Green precipitate is formed. / The green colour of the solution becomes paler (colourless). 1

$FeSO_4 + 2NaOH \rightarrow Fe(OH)_2 + Na_2SO_4$ 1

or $Fe^{2+} + 2OH^- \rightarrow Fe(OH)_2$ (1)

4

Marks

9. Chemical Knowledge (6 marks)

3 sets of tests needed each of which carries 2 marks: 3 x 2

- Suitable test matches the intention to distinguish certain compounds ---------- 1 mark
- Correct observation / result ---------- 1 mark

Mark the tests in a logical sequence and accept any suitable tests and results such as:

Conduct flame tests using the samples. (1)
Only the two sodium compounds (NaOCl and Na_2SO_4) give a golden yellow flame. (1)

Heat samples with NaOH(aq). (1)
Only the two ammonium compounds (NH_4Cl and NH_4NO_3) give an alkaline gas / ammonia. (1)

Add HCl(aq). (1)
Only NaOCl(aq) gives greenish yellow gas / chlorine. (1)

Touch with moist litmus paper / colour flower petal (1)
Only NaOCl gives bleaching effect. (1)

Add acidified $BaCl_2$(aq) to aqueous solutions of the two sodium compounds. (1)
Only Na_2SO_4(aq) gives a white precipitate. (1)

Add acidified $AgNO_3$(aq) to aqueous solutions of the two ammonium compounds. (1)
Only NH_4Cl(aq) gives a white precipitate. (1)

6

Effective communication (3 marks)

General guidelines for marking effective communication:

(i) The mark for effective communication should relate to the candidate's knowledge in chemistry. A candidate who writes a paragraph which is *totally* unrelated to the question should be awarded zero marks both for chemical knowledge and effective communication.

(ii) The table below illustrates the relationship between the mark for chemical knowledge and the *maximum* mark for effective communication, together with the points to be considered in marking effective communication.

mark for chemical knowledge	*maximum* mark for effective communication	points to be considered in paragraph (iii) below
4 or above	3	(A), (B) and (C)
3 or below	2	(B) and (C)

(iii) The three marks for effective communication are awarded as follows:

(A) the ability to present ideas in a precise manner, including the proper use of chemical terms (this mark should not be awarded to answers which contain a lot of incorrect/superfluous material); 1

(B) the ability to present ideas in a systematic manner (i.e., the answer is easy to follow); 1

(C) the ability to present the answer in paragraph form and to express ideas using full sentences. 1

3

PART II

Marks

10. (a) From the curve, 1 mole of $P(g)$ reacts with 2 moles of $Q(g)$ to give 1 mole of $R(g)$. — 1

Equation:

$P(g) + 2Q(g) \rightarrow R(g)$ — 1

(b) The time required will become longer.

In a larger container, the concentrations of reactants become less and hence the collision frequency decreases. — 1

(c) Colliding molecules will undergo reaction only if they possess an energy greater than the activation energy and collide in the right orientation. — 1

1

5

11. (a) K_c increases with temperature. i.e. the equilibrium position shifts to the right when temperature is increased — 1

$\therefore$ The forward reaction is endothermic — 1

(b)

	$H_2(g)$	+ $CO_2(g)$	$\rightleftharpoons$	$CO(g)$	+ $H_2O(g)$
initial conc.	0.5	0.5		0	0
eqm. conc.	0.5-y	0.5-y		y	y

$$K_c = \frac{[CO(g)][H_2O(g)]}{[H_2(g)][CO_2(g)]}$$

$$1.23 \times 10^{-1} = \frac{y^2}{(0.5 - y)(0.5 - y)}$$ — 1

$y = 0.130$ or 0.13 (mol dm^{-3}) — 1

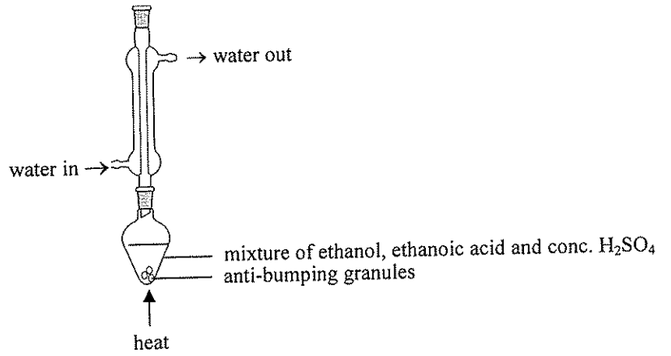
(c) The rate of the backward reaction increases. — 1

5

Marks

12. (a) concentrated sulphuric acid / conc. H_2SO_4 — 1

(b) — 1+1



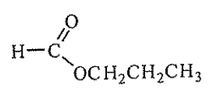
(1 mark for the diagram; 1 mark for direction of water flow in the condenser)
(0 marks for the wrong set-up)

(c) Iodine has a simple molecular structure / Attraction between I_2 molecules is due to the weak van der Waals' forces. — 1

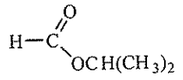
Sodium iodide has an ionic structure / Attraction between Na^+ and I^- ions is due to strong ionic bonds. — 1

The strength of inter-particle attraction in ethyl ethanoate is comparable to that in iodine. (Indication of an understanding of the idea of 'like dissolve like' in terms of the strength of attraction between particles.) — 1

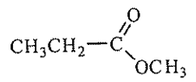
(d) Any ONE of the following: — 1+1



propyl methanoate



methylethyl methanoate
(iso-propyl methanoate)



methyl propanoate

(1 mark for structure, 1 mark for name.)

8

13. For (a) and (b) below, accept other correct reaction sequences.

(a) $CH_3CH_2CH_2Cl \xrightarrow{a} b \xrightarrow{c} CH_3CH_2CO_2H$ — 3

a : NaOH(aq)

b : $CH_3CH_2CH_2OH$

c : $Cr_2O_7^{2-}/H^+$ or MnO_4^-/H^+

(b) $CH_3CH{=}CH_2 \xrightarrow{d} e \xrightarrow{f} CH_3COCH_3$ — 3

d : (1) conc. H_2SO_4 ; (2) H_2O

e : $CH_3CH(OH)CH_3$

f : $Cr_2O_7^{2-}/H^+$

6

		Marks
14.	Sodium oxide dissolves in water to give an alkaline solution.	1
	$Na_2O(aq) + H_2O(l) \rightarrow 2Na^+(aq) + 2OH^-(aq)$ (alkaline)	1
	Sulphur dioxide dissolves in water to give an acidic solution.	1
	$SO_2(aq) + H_2O(l) \rightleftharpoons SO_3^-(aq) + 2H^+(aq)$ (acidic)	1
		4

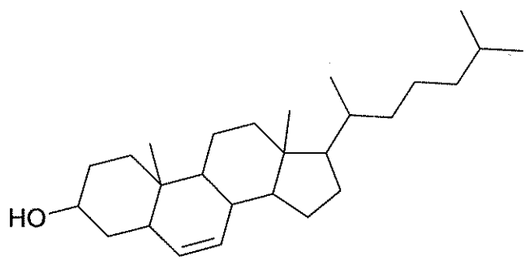
Paper 2

		Marks
(1)	**Industrial Chemistry**	
(a) (i)	$ClO_3^-(aq) + 5Cl^-(aq) + 6H^+(aq) \rightarrow 3Cl_2(g) + 3H_2O(l)$	1
(ii)	Rate = $k[ClO_3^-(aq)]^x [Cl^-(aq)]^y [H^+(aq)]^z$	1
	$\frac{1.0 \times 10^{-5}}{4.0 \times 10^{-5}} = \frac{(0.08)^x (0.15)^y (0.2)^z}{(0.08)^x (0.15)^y (0.4)^z}$	2
	$\Rightarrow \frac{1}{4} = \left(\frac{2}{4}\right)^z$ $-\log 4 = z \log \frac{1}{2}$	
	$z = 2$	
	similarly, $x = 1$ and $y = 1$	
(iii)	Rate = $k[ClO_3^-(aq)] [Cl^-(aq)] [H^+(aq)]^2$	1
	k = Rate /($[ClO_3^-] [Cl^-] [H^+]^2$)	
	$= (1.0 \times 10^{-5}) / [0.08 \times 0.15 \times 0.2^2]$	2
	$= 2.08 \times 10^{-2}$ mol^{-3} dm^{9}s^{-1}	
(iv)	Arrhenius equation:	1
	$\log k = C - E_A/2.3 \times RT$	
	$\log 2 = (E_A/R)(1/298 - 1/308)/2.3$	2
	$E_A = 52.9$ kJ mol^{-1}	
		10
(b)	Purified N_2 and H_2 (ratio 1:3) are passed over iron catalyst at 450°C and 200 atm pressure :	2
	$N_2 + 3H_2 \rightleftharpoons 2NH_3$	
	Ammonia is mixed with O_2 (excess air) and passed over a platinum catalyst at 400°C :	
	$4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$	3
	$2NO + O_2 \rightarrow 2NO_2$	
	Resulting gaseous mixture is passed through water :	
	$4NO_2 + O_2 + 2H_2O \rightarrow 4HNO_3$	1
		6

			Marks
(c)	(i)	atom economy = molar mass of desirable product / sum of molar masses of all products = molar mass of methylpropene /(MM of methylpropene+ethanol+sodium bromide) = 56/(56+46+102.9) x 100% = 27.3%	2
	(ii)	Examples of other factors (Any TWO): • Waste Minimisation at Source • Use of Catalysts in place of Reagents • Use of Non-Toxic Reagents • Use of Renewable Resources • Use of Solvent Free or Recyclable Environmentally Benign Solvent systems	2
			4

(2) Materials Chemistry

(a) (i)



2

(ii) Molecules in 'true liquid' have no intrinsic order. 1
Molecules in liquid crystal possess some degree of translational freedom with certain orientation preference in one or two direction(s). 1

(iii) The molecules line up in positions such that they are slightly twisted from the molecules next to them giving rise to a helical-like arrangement. 2

(iv) In LCD, liquid crystals are packed between a polariser and an analyser. 1
When light passes through the polariser, it will be polarised in the direction allowed by the polariser. 1
The polarised light will be guided by the molecules in each layer of the liquid crystals. 1
The polarised light is rotated by the desired angle and hence can pass through the analyser to give rise to bright regions on the LCD. 1

10

			Marks
(b)	(i)	Thermoplastics are made up of molecules with long carbon chains. The attractions between the polymers are weak van der Waals' forces. At elevated temperatures, the molecules can move relative to each other (translational motion).	1
		In thermosetting plastics, there are cross-links between polymer molecules / covalent bonds are formed between the polymer chains. There is little motion between the chains. Thermosetting plastics do not melt upon heating / cannot be reshaped at high temperature. But, thermoplastics soften upon heating / can be moulded at high temperatures.	1 1
		(1 mark for a description of the structure of thermoplastics; 1 mark for that of thermosetting plastics; 1 mark for the thermal property.)	
	(ii)	(I) $n\ H_2C{=}CH_2 \longrightarrow -\left[\begin{matrix}H & H\\ | & |\\ C & -C\\ | & |\\ H & H\end{matrix}\right]_n-$	1
		(II) $-\begin{matrix}H & H\\ | & |\\ C & -C\\ | & |\\ H & H\end{matrix}-$	1
	(iii)	(I) $HO-\begin{matrix}CH_3\\ |\\ C\\ |\\ H\end{matrix}-CO_2H$	1
		(II) 2-hydroxypropanoic acid	1
		(III) condensation polymerisation	1
		(IV) • Esters readily undergo hydrolysis in the presence of acids / alkalis • Polymers in PLA will degrade more readily than those of PE in the environment. • Microbes use lactic acid (PLA) as food. PLA is biodegradable. • PLA contains a lower carbon content. It burns more completely during incineration. (Any TWO)	2
			10

			Marks
(3)	**Analytical Chemistry**		
(a)	(i)	number of carbon atoms = 0.621(58)/12 = 3 number of H atoms = 0.103 (58)/1 = 6 number of O atoms = 0.276 (58) / 16 = 1 Molecular formula of **G** is C_3H_6O.	2
	(ii)	From the IR spectrum, the presence of a sharp absorption peak at 1740 cm^{-1} indicates the presence of a carbonyl group.	1
		From the mass spectrum, the peaks at m/e 29 corresponds to $C_2H_5^+$ and	1
		the peak at m/e 58 corresponds to $CH_3CH_2CHO^+$.	1
		The structural formula of **G** should be CH_3CH_2CHO.	1
	(iii)	Add 2,4-dinitrophenylhydrazine to **G** to prepare the corresponding 2,4-dinitrophenylhydrazone.	1
		Recrystallize the 2,4-dinitrophenylhydrazone.	1
		Measure its melting point using a melting point apparatus.	1
		A sharp melting point, which is the same as that quoted in the literature, will support the deduction of **G**.	1
			10
(b)	(i)	$3CH_3CH_2OH + 2Cr_2O_7^{2-} + 16H^+ \rightarrow 3CH_3CO_2H + 4Cr^{3+} + 11H_2O$	1
	(ii)	• large formula mass	1
		• stable in air	1
	(iii)	Retain some portions and allow a longer period of time, say, 2 days.	1
		Perform the titration again. If the titre is consistent with the previous result, there has been complete oxidation of ethanol.	1
	(iv)	$Cr_2O_7^{2-} + 6Fe^{2+} + 14H^+ \rightarrow 2Cr^{3+} + 6Fe^{3+} + 7H_2O$	1
		Amount of Fe^{2+} used in titration = $0.118 \times 12.23 \times 10^{-3}$ mol	1
		Amount of excess $Cr_2O_7^{2-} = \frac{1}{6} \times 0.118 \times 12.23 \times 10^{-3}$ mol $= 2.405 \times 10^{-4}$ mol	
		Amount of $Cr_2O_7^{2-}$ added = $0.156 \times 25 \times 10^{-3} = 3.9 \times 10^{-3}$ mol	
		Amount of $Cr_2O_7^{2-}$ that react with CH_3CH_2OH	1
		$= 3.9 \times 10^{-3} - 2.405 \times 10^{-4}$ $= 3.659 \times 10^{-3}$ mol	1
		Concentration of ethanol in the brand of spirit $= \frac{3.659 \times 10^{-3} \times 10}{10 \times 10^{-3}} \times \frac{3}{2}$ $= 5.49$ mol dm^{-3}	1
			10

選取示例

本刊示例取材自先導測驗中學生答卷的真正樣本，用以顯示典型的表現。一併參考這些示例與等級描述，有助釐清各等級的預期水平。

要爲課程內所有課題或樣本試卷內所有試題提供示例，是不切實際的，因此，光碟內的示例只選取個別試題的答卷。這些示例分別代表五個等級的典型表現，並涵蓋不同題目種類。示例旁邊會列出有關試題及其建議答案載於本刊的頁數，方便讀者參考。

請讀者留意，這些示例雖經過細心挑選並附有註釋，以說明每個等級的典型表現，但它們還只屬暫定稿。2012 年首屆香港中學文憑考試後，會從考生的真正答卷中選取樣本，提供更多示例讓讀者參考。