General Marking Instructions

1. In order to maintain a uniform standard in marking, markers should adhere to the marking scheme agreed at the markers' meeting.

2. The marking scheme may not exhaust all possible answers for each question. Markers should exercise their professional discretion and judgment in accepting alternative answers that are not in the marking scheme but are correct and well reasoned.

3. In questions asking for a specified number of reasons or examples etc. and a candidate gives more than the required number, the extra answers should not be marked. For instance, in a question asking candidates to provide two examples, and if a candidate gives three answers, only the first two should be marked.

4. In cases where a candidate answers more questions than required, the answers to all questions should be marked. However, the excess answer(s) receiving the lowest score(s) will be disregarded in the calculation of the final mark.

5. Award zero marks for answers which are contradictory.

6. Chemical equations should be balanced except those in reaction schemes for organic synthesis. For energetics, the chemical equations given should include the correct state symbols of the chemical species involved.

7. In the question paper, questions which assess candidates' communication skills are marked with an asterisk (*). For these questions, the mark for effective communication (1 mark per question) will be awarded if candidates can produce answers which are easily understandable. No marks for effective communication will be awarded if the answers produced by candidates contain a lot of irrelevant materials and/or wrong concepts in chemistry.

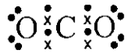
SECTION B

Part I

Marks

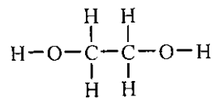
1. (a) (i) Layers of graphite are only held together by van der Waals' forces. 1

(ii) Graphene can conduct electricity because it has delocalised electrons. 1

(iii)  1

(b) Not agree. Graphene layer has of a giant covalent structure. / A large amount of energy is needed during melting to destroy the large amount of strong covalent bonds between atoms. 1

(c)
- C_{60} has a spherical structure. 1
- C_{60} has a simple molecular structure. 1
- The van der Waals' forces between C_{60} molecules are of comparable strength as those in molecules of organic solvents. 1

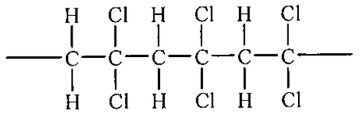
2.  1

It is soluble in water because:
- It has a small molecular size. 1
- The hydroxyl groups in it can form hydrogen bonds with water. 1

3. (a) Add in $Br_2(aq)$ / acidified $KMnO_4(aq)$ / neutral or alkaline $KMnO_4(aq)$. 1
Reddish brown $Br_2(aq)$ decolourised / Purple $KMnO_4(aq)$ decolourised / Purple $KMnO_4(aq)$ turns brown. 1

(b) (i) 1,1-dichloroethene 1

(ii) addition polymerisation 1

(iii)  1

(c) 'Saran' is more heat resistant. 1
It is because the polar attraction force between 'Saran' polymer chains is stronger than that between PE. 1

(d) Incineration of food wrap made from 'Saran' will produce toxic gases while that made from PE will not. 1

Marks

4. • Silver can be obtained by heating oxide of silver directly, while copper and magnesium cannot be obtained by similar method. 1
• By heating with charcoal, oxide of copper can be reduced to copper, while magnesium cannot be obtained by similar method. 1
• Magnesium can only be obtained by electrolysis of its oxide in molten state. 1
• As more stable is the metal oxide, the more reactive is the metal. So, the order of reactivity is: magnesium > copper > silver 1
• Communication mark 1

5. (a) Wearing protective gloves / plastic gloves / gown / safety goggles 1

(b) The statement is not correct. The strength of an acid is not related to its concentration. 1

(c) Concentrated sulphuric acid reacts with copper to liberate a colourless gas. 1
Concentrated nitric acid reacts with copper to liberate a brown gas. 1
When concentrated ethanoic acid is added to copper granules, there are no observable changes / no reactions occur. 1

6. (a) (i) Components having different boiling points can be separated from each other by fractional distillation. 1
The longer the carbon chain, the higher is the boiling point. 1

(ii) Cracking of heavy oil / heavy hydrocarbons 1

(iii) The enthalpy change when one mole of a compound burns completely under standard conditions / 25°C and 1 atm. 1

$C_8H_{18}(l) + \frac{25}{2} O_2(g) \rightarrow 8CO_2(g) + 9H_2O(l)$ 1

(b) (i) Catalytic converter 1

(ii) The standard enthalpy change of the reaction 3
$= 2(-394) - 2(-110.5) - 2(90.3)$
$= -747.6$ kJ mol^{-1}

Marks

7. (a) Mass of HCl in 1000 cm^3 of the concentrated acid = 1180 x 36% = 425 g 2
Formula mass of HCl = 36.5
Concentration = 425 / 36.5 = 11.6 mol dm^{-3}

(b) (i) • Weigh accurately the amount of sodium carbonate needed and dissolve it using deionised water / distilled water. 1
• Transfer all the solution made to a volumetric flask, add deionised water / distilled water to the graduation mark of the flask, and mix the content thoroughly. 1

(ii) No. of mole of H^+ present in the diluted acid = 1.06 x (10/1000) x 2 3
= 0.0212
Concentration of the acid in the bottle = [0.0212 / (20.30/1000)] x 10
= 10.4 mol dm^{-3}

(c) Some HCl(g) escaped from the concentrated acid. 1

8. (a) (i) The electrode dissolves / becomes smaller / becomes thinner gradually. 1

(ii) Colourless gas / bubbles given out. 1

(b) (i) $4OH^- \rightarrow 2H_2O + O_2 + 4e^-$ 1

(ii) $Ag^+ + e^- \rightarrow Ag$ 1

(c)

electrode **W**	electrode **Z**
anode	cathode

1

(d) Electrons would not flow through the electric wires / no observable changes on all electrodes / no reaction occurs because ethanol is not an electrolyte / cannot conduct electricity. 1

9. (a) (i) A blue precipitate is obtained. 1

(ii) $Cu^{2+}(aq) + 2OH^-(aq) \rightarrow Cu(OH)_2(s)$ / $CuSO_4 + 2NaOH \rightarrow Cu(OH)_2 + Na_2SO_4$ 1

(b) (i) Purple acidified potassium permanganate solution is decolourised / turns into colourless. 1

(ii) (1) Redox / oxidation-reduction / reduction of acidified potassium permanganate 1

(2) $2MnO_4^-(aq) + 5SO_3^{2-}(aq) + 6H^+(aq) \rightarrow 2Mn^{2+}(aq) + 5SO_4^{2-}(aq) + 3H_2O(l)$ 1

Part II

Marks

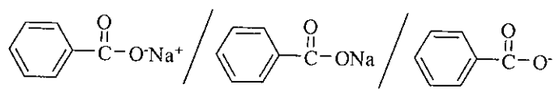
10. • Proper way to follow the progress of the reaction (e.g. measure the volume of CO_2 evolved / measure the loss in mass of the reaction mixture over a certain time interval / measure the pressure of the CO_2 formed in a sealed reaction container.) 1
• Dilute 1M HCl to different concentrations by adding water. 1
• Repeat the experiment with the diluted HCl. 1
• State one condition for performing fair comparison (e.g $CaCO_3$ used should be of the same amount / under same experimental conditions such as same temperature or pressure) 1
• Communication mark 1

11. (a) Vanadium exhibits variable oxidation numbers and its ions in aqueous solutions carry colours. 1

(b) (i) 1 mol of $VO_2^+(aq)$ ions gains 2 mol of electrons from 1 mol of $SO_2(g)$ to become 1 mol of $V^{3+}(aq)$ ions. 1
$V^{3+}(aq)$ ion is green in colour. 1

(ii) $SO_2(g) + VO_2^+(aq) \rightarrow SO_4^{2-}(aq) + V^{3+}(aq)$ 1

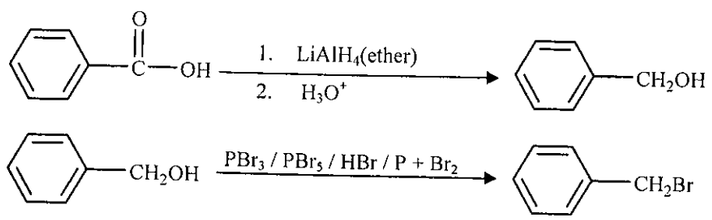
12. (a) (i) alkaline hydrolysis 1

(ii)  1

(iii) $HCl(aq) / H_2SO_4(aq)$ 1

(iv) **X** (sodium benzoate) is an ionic compound which has stronger interactions with water. / Benzoic acid exists as molecules which have weaker intermolecular interactions with water. / 1
X is an ionic compound while benzoic acid exists as molecules.

(v) Filter the mixture to obtain the solid benzoic acid. Wash it with deionised water and then dry in oven. 1

(b)  3

Marks

13. (a) (i)

	$2NO(g)$	+	$O_2(g)$	⇌	$2NO_2(g)$
Initial conc.:	1.02/50 = 0.0204		1.29/50 = 0.0258		0
Equil. conc.:	0.0204 x 0.39 = 0.007956		0.0258–0.006222 = 0.019578		0.0204 x 0.61 = 0.012444

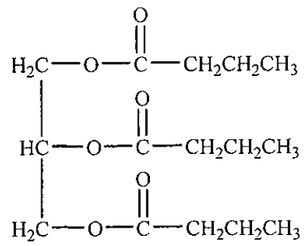
3

$K_c = \dfrac{(0.012444)^2}{(0.007956)^2(0.019578)}$ / $K_c = \dfrac{[NO_2]^2}{[NO]^2[O_2]}$

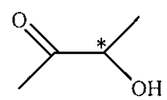
$= 125\ dm^3\ mol^{-1}$

(ii) No change, because K_c is independent of concentration / only depends on temperature. 1

(b) As revealed from the data, when temperature increases, K_c decreases. Therefore the forward reaction is exothermic. / 1
As higher temperature favours endothermic side of reaction, so the forward reaction is exothermic.

14. (a)  1

(b) methylpropanoic acid 1

(c) (i)  1

(ii) Correct chemical reagent 1
Correct observations with comparison between the tests on **Q** and **Z** 1

Possible tests and the corresponding observations:

$Cr_2O_7^{2-} / H^+$	**Q** – no change; **Z** – from orange to green
MnO_4^- / H^+	**Q** – no change; **Z** – from purple to colourless
MnO_4^- / OH^-	**Q** – no change; **Z** – formation of brown ppt.
2,4-DNP	**Q** – no change; **Z** – formation of orange ppt.
CH_3CH_2OH / H^+ / heat	**Q** – fruity smell compound formed; **Z** – no change
CH_3COOH / H^+ / heat	**Q** – no change; **Z** – fruity smell compound formed
CO_3^{2-}	**Q** – formation of gas (CO_2); **Z** – no change
HCO_3^-	**Q** – formation of gas (CO_2); **Z** – no change

(2,4-DNP = 2,4-dinitrophenylhydrazine)

(d) hydrogenation / addition of hydrogen 1