



سَلْطَنَةُ عُمَانِ  
وَزَارَةُ التَّحْقِيقِ وَالتَّعْلِيمِ

امتحان دبلوم التعليم العام للمدارس الخاصة (ثنائية اللغة)

للعام الدراسي ١٤٣٩/١٤٤٠ هـ - ٢٠١٨ / ٢٠١٩ م

الدور الثاني - الفصل الدراسي الأول

- زمن الإجابة: ثلاث ساعات.
- الإجابة في الورقة نفسها.

- تنبيه: المادة: الكيمياء.
- الأسئلة في (١٦) صفحة.

تعليمات مهمة:

- يجب على الممتحن التأكد من استلام دفتر امتحانه، مغلفاً بغلاف بلاستيكي شفاف وغير ممزق، وهو مسؤول عنه حتى يسلمه لمراقبي اللجنة بعد الانتهاء من الإجابة.
- يجب الالتزام بضوابط إدارة امتحانات دبلوم التعليم العام وما في مستواه وأية مخالفة لهذه الضوابط تعرضك للتدابير والإجراءات والعقوبات المنصوص عليها بالقرار الوزاري رقم ٥٨٨ / ٢٠١٥.
- يقوم المتقدم بالإجابة عن أسئلة الامتحان المقالية بقلم الحبر (الأزرق أو الأسود).
- يقوم المتقدم بالإجابة عن أسئلة الاختيار من متعدد بتظليل الشكل ( ) وفق النموذج الآتي:  
س - عاصمة سلطنة عمان هي:  
القاهرة ☐ الدوحة ☐  
مسقط ☒ أبوظبي ☐
- ملاحظة: يتم تظليل الشكل ( ) باستخدام القلم الرصاص وعند الخطأ، امسح بعناية لإجراء التغيير.
- يجب على الممتحن الامتناع عن استخدام الهاتف المحمول وأجهزة النداء الآلي وألات التصوير والحواسيب الشخصية والساعات الرقمية الذكية والآلات الحاسبة ذات الذاكرة التخزينية والمجلات والصحف والكتب الدراسية والدفاتر والمذكرات والحقائب اليدوية والآلات الحادة أو الأسلحة أيّاً كان نوعها وأي شيء له علاقة بالامتحان.
- يجب على الممتحن الامتناع عن إجراءات التفتيش داخل المركز طوال أيام الامتحان.

صحيح ☒ غير صحيح ☐ ☒ ☐ ☐ ☐ ☐

مُسَوَّدَة، لا يتم تصحيحها

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**Question 1: Multiple Choice Items****(14 marks)**

There are 14 multiple-choice items worth two marks each.

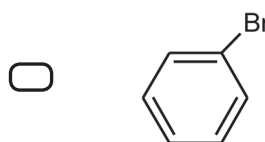
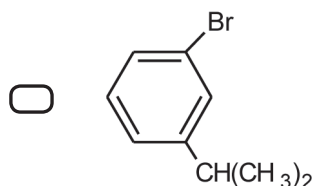
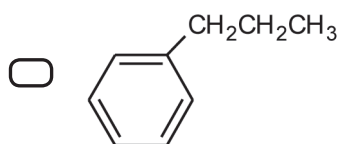
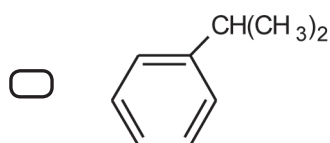
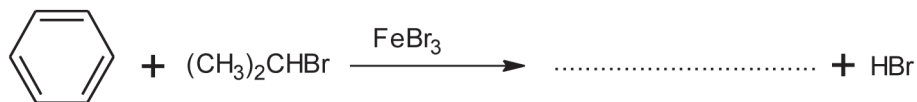
Shade in the bubble (☐) next to the **correct** answer for each of the following items.

- 1) What is the type of bond between the metal and the ligand in a complex?
- ☐ an ionic bond.
  - ☐ a metallic bond.
  - ☐ a hydrogen bond.
  - ☐ a coordinate covalent bond.
- 2) Which of the following is correct about the  $\text{Fe}(\text{C}_2\text{O}_4)_3^{3-}$  complex ion?
- ☐ Six-membered ring formed between ligand  $\text{C}_2\text{O}_4^{2-}$  and iron ion.
  - ☐ Six dative covalent bonds are formed in this complex ion.
  - ☐ The formation of this complex ion decreases its stability.
  - ☐ The oxidation number of the Fe in this complex ion is +2.
- 3) Which of the following statements about  $[\text{CuCl}_4]\text{Cl}_2$  complex compound is correct?
- ☐ The acidic ligand is  $\text{Cl}^-$ .
  - ☐ The oxidation number of copper in this complex is +4.
  - ☐ The complex formed when the ligands are attracted to the metal ions.
  - ☐ Six dative covalent bonds formed between ligands and the metal ion.
- 4) Which of the following statements is incorrect about bromination of the benzene ring?
- ☐ It is an electrophilic addition reaction.
  - ☐ The electrophile in this reaction is the bromine ion.
  - ☐ Further bromination to bromobenzene can occur.
  - ☐ The role of aluminium bromide in this reaction is to produce the electrophile.

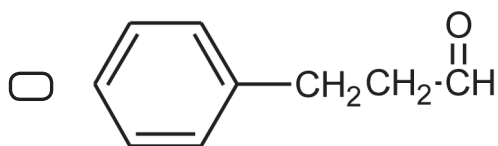
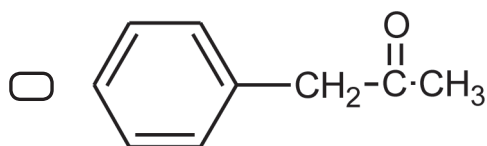
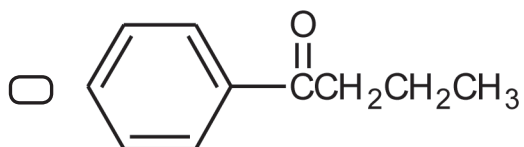
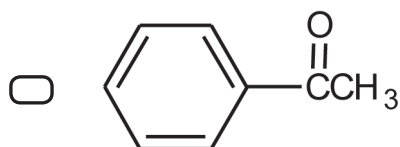
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## Question 1 continued

- 5) What is the product from the reaction of benzene with halogenoalkane in the presence of halogen carrier?



- 6) Benzene reacts with  $\text{C}_3\text{H}_7\text{COCl}$  in the presence of a suitable catalyst. What is the structural formula of the product you would expect from this reaction?



7) Which of the following statements about the reactions of acyl chlorides is correct?

- 8) What does X represent in the following reaction?



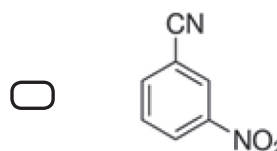
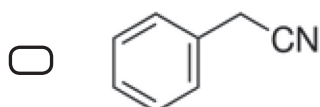
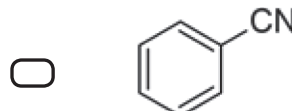
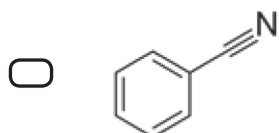
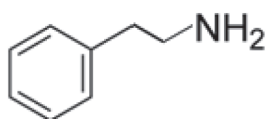
9) What is the correct order for compounds (A, B, C and D) according to the acid strength from the weakest to the strongest carboxylic acid?

- 10) Diluted sulfuric acid was added to phenyl amine until the reaction was just completed. What the resulting mixture will be like?

- 3

## Question 1 continued

- 11) Compound X of a molecular formula  $C_8H_9N$  undergoes reduction reaction to form the following compound. What is the structural formula of X?



- 12) What is the sequence of reagents that will accomplish the synthesis of phenylamine from the benzene as the following reaction?



	Reaction 1	Reaction 2	Reaction 3
<input type="radio"/>	$HNO_3, H_2SO_4$	$Sn, HCl$	$NaOH$
<input type="radio"/>	$HNO_3, H_2SO_4$	$Sn, HCl$	$H_2O$
<input type="radio"/>	$Fe, HCl$	$HNO_3, H_2SO_4$	$H_2O$
<input type="radio"/>	$HNO_3$	$Sn, HCl$	$NaOH$

## Question 1 continued

13) How many repeat units are in the following polymer ?

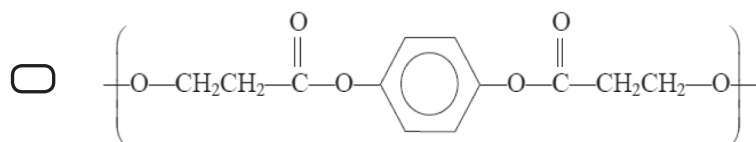
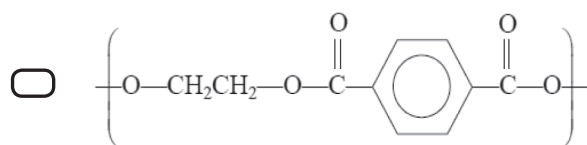
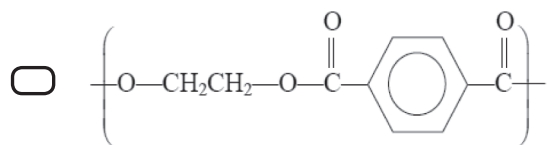
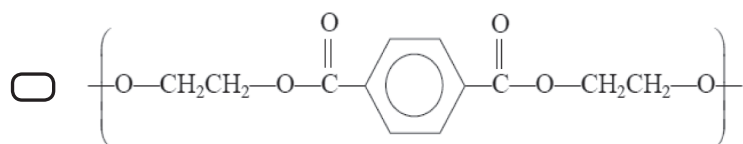

☐ 2

☐ 3

☐ 4

☐ 5

14) What is the repeat unit of terylene, that formed from  $\text{HOCH}_2\text{CH}_2\text{OH}$  and  $\text{HO}_2\text{C-C}_6\text{H}_4\text{-CO}_2\text{H}$ ?



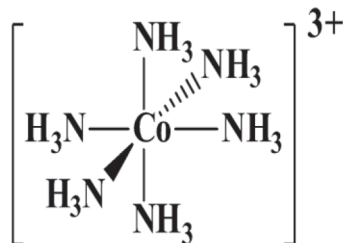
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**Question 2: Extended Questions****(56 marks)**

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Write your answer for each of the following questions in the space provided.  
Be sure to show all your work, including the correct units where applicable.

15) The structure of a complex ion is shown below. Study it to answer the following questions.



a. Which element, cobalt or calcium has higher density?

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b. Write the name of the shape of this complex ion.

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c. This complex ion contains monodentate ligands.

(i) What is meant by the term ligands?

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(ii) Explain why these ligands are considered as monodentate ligands.

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d. Write the chemical formula of the following:

(i) The metal ion of this complex ion.

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(ii) The ligand of this complex ion.

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## Question 2 continued

- e. How many co-ordinate bonds are formed in this complex ion? Explain your answer.

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- f. Write the electronic configuration of cobalt ion using [Ar] to represent the argon core.

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- g. If all the ligands of this complex ion are replaced with four ligands of water molecules to form new complex ion with same cobalt ion.

- (i) What will be the name of the shape of the new complex ion?

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- (ii) Which complex (first or new complex ion) will have stronger co-ordinate bonds? Explain your answer.

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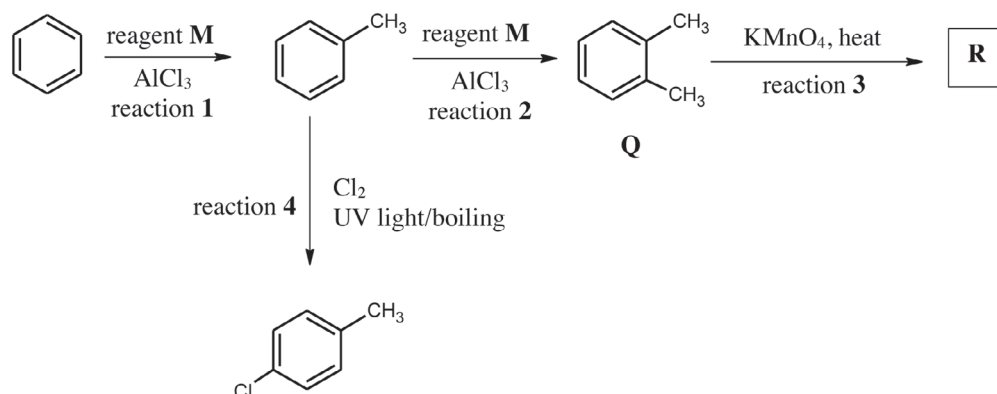
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## Question 2 continued

- 16) A student makes the following diagram to show some reaction series of benzene. Study it and answer the following questions



- a. Why all the carbon-carbon bonds in benzene have the same length?
- \_\_\_\_\_
- b. Describe the role of AlCl<sub>3</sub> with reagent M in reaction 1.
- \_\_\_\_\_
- \_\_\_\_\_
- c. Draw the structure of the intermediate ion formed when the electrophile attacks the benzene ring in reaction 1.
- \_\_\_\_\_
- \_\_\_\_\_
- d. Write the IUPAC name of compound Q.
- \_\_\_\_\_
- e. Draw the structural formula of the organic compound R.
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

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## Question 2 continued

- f. The student made a mistake in reaction 4, help him to determine it and suggest the right way to carry out the reaction.

(i) Mistake: \_\_\_\_\_

(ii) Right reaction: \_\_\_\_\_

- 17) Benzene with two substituents –OH and –NO<sub>2</sub> attached to two carbon atoms, produces three possible products. Draw them.

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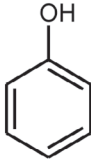
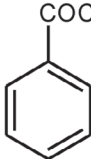
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## Question 2 continued

- 18) Four compounds are shown in the table below. Study them to answer the following question..

Compound	A	B	C	D
Formula	$\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$	$\text{CH}_3\text{CH}_2\text{COOH}$		

- a. Explain why compound **B** is stronger acid than compound **A**.

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- b. Write the structural formulae of the organic products formed in the following reactions:

- (i) **B** with Na.

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- (ii) **C** with **D**

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- (iii) **D** with water

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- c. Both compounds **D** and  $\text{CH}_3\text{CH}_2\text{Cl}$  of equal concentration reacted with water individually in different test tubes. Which compound can react faster with water? Explain your answer.

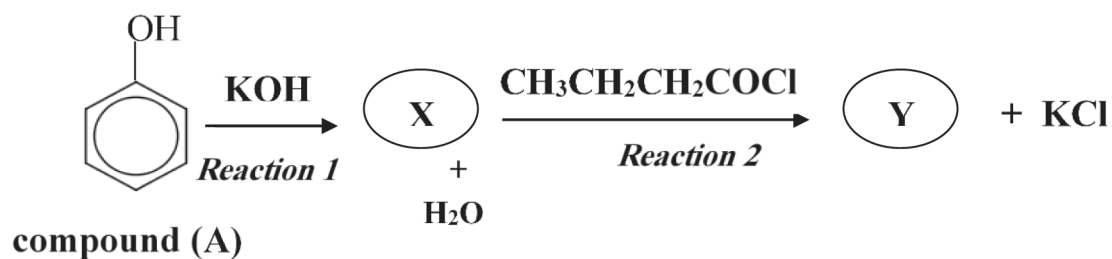
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## Question 2 continued

- 19) A series of two chemical reactions, was carried out, as in the flowchart below. Study it to answer the following questions.



- a. Write two properties of acyl chlorides.

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- b. To which family of organic compounds does compound Y belong?

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- c. Draw the structural formulae of the organic compounds represented by (X and Y).

X: \_\_\_\_\_

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Y: \_\_\_\_\_

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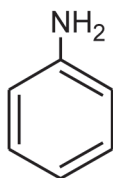
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## Question 2 continued

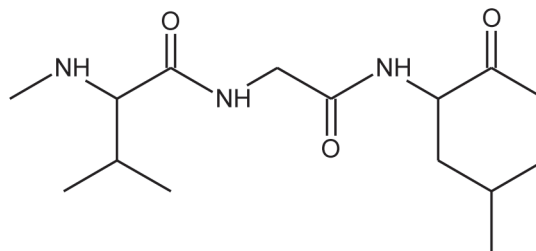
20) Study the following compounds to answer the questions below.



**A**



**B**



**C**

a. Why compound **A** is a stronger base than  $\text{NH}_3$ ?

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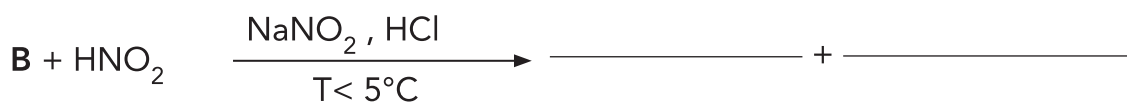


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b. Complete the following reaction:



c. Explain how peptides bonds formed in compound **C**.

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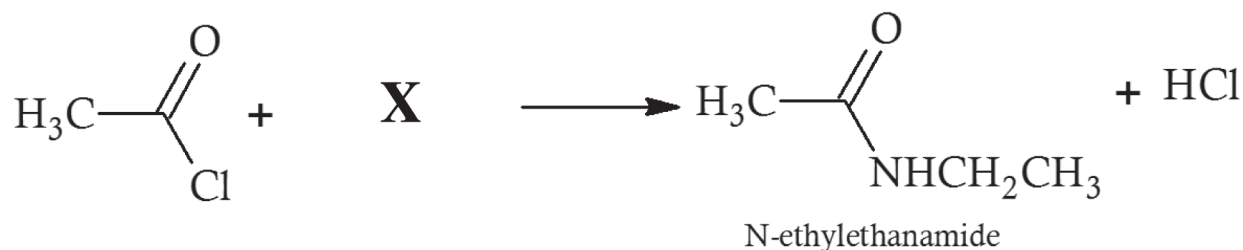
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## Question 2 continued

21) N-ethylethanamide can be prepared as follows:



a. Draw the structural formula of compound X.

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b. Write the structural formulae of the organic products in the following reactions:

(i) Hydrolysis of N-ethylethanamide using NaOH.

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(ii) Reduction of N-ethylethanamide using  $\text{LiAlH}_4$ .

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c. N-ethylethanamide is a base.

(i) Draw the structural formulae of the products produced from the hydrolysis of N-ethylethanamide in dilute sulfuric acid.

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(ii) Which is less basic N-ethylethanamide or diethylamine? Explain your answer.

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## Question 2 continued

- 22) The following grid shows three polymerisation reactions. Study it and answer the following questions.

Reaction <b>1</b>	$n[A] \longrightarrow \left( \begin{array}{c} \text{CH}_3 \\   \\ \text{---} \text{C} \text{---} \text{O} \text{---} \\    \\ \text{O} \end{array} \right)_n + (2n-1) \text{H}_2\text{O}$
Reaction <b>2</b>	$n \text{HO}-\overset{\text{O}}{\parallel}{\text{C}}-\text{C}_6\text{H}_4-\overset{\text{O}}{\parallel}{\text{C}}-\text{OH} + n \text{HO}\cdot\text{CH}_2\text{CH}_2\text{CH}_2\cdot\text{OH} \longrightarrow [\text{B}] + 2n\text{X}$
Reaction <b>3</b>	$n \begin{array}{c} \text{H} \quad \text{Cl} \\ \diagdown \quad / \\ \text{C}=\text{C} \\ / \quad \diagdown \\ \text{H} \quad \text{H} \end{array} \longrightarrow \left( \text{CH}_2-\text{CHCl} \right)_n$

- a. Draw the structural formulae for the following:

- (i) Monomer **A** in reaction 1:

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- (ii) Polymer **B** in reaction 2:

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- b. What is the type of polymerisation in:

- (i) Reaction 2: \_\_\_\_\_

- (ii) Reaction 3: \_\_\_\_\_

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## Question 2 continued

- c. What are the intermolecular forces that are holding the chains of the polymer in reaction 3?

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- d. The product **X** is a small molecule eliminated during the polymerisation reaction 2. What is the name or the formula of **X**?

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- e. What is the difference between the two types of condensation polymers?

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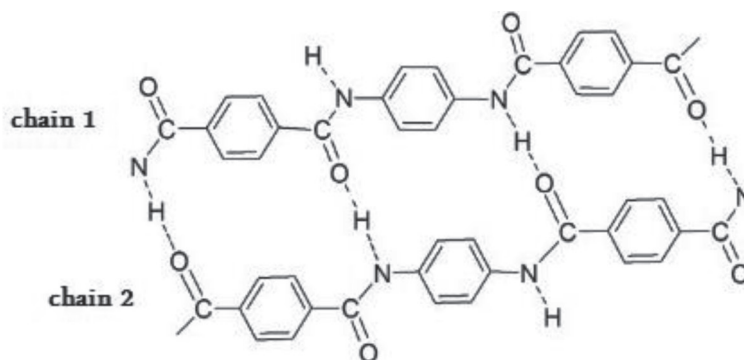
- f. What is the functional group found in the polymer formed in reaction 1?

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## Question 2 continued

- 23) Kevlar is a polymer which is five times stronger than steel. It can align side by side with other chain.



- a. What is the type of bond formed between the two chains in this polymer?

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- b. Is Kevlar polymer type I or type II?

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- c. Draw the monomer(s) that form(s) this polymer.

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[ End of Examination ]

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## PERIODIC TABLE OF THE ELEMENTS

1 H 1.008 Hydrogen	<div>Atomic Number → 1</div> <div>Symbol → H</div> <div>1.008 ← Atomic Mass</div> <div>Hydrogen ← Name</div>																2 He 4.002602 Helium																																																																																																																																																																																																																																																																																																																																																																																																																																																					
3 Li 6.94 Lithium	4 Be 9.0121831 Beryllium	5 B 10.81 Boron	6 C 12.011 Carbon	7 N 14.007 Nitrogen	8 O 15.999 Oxygen	9 F 18.998403163 Fluorine	10 Ne 20.1797 Neon	11 Na 22.98976928 Sodium	12 Mg 24.305 Magnesium	13 Al 26.9815385 Aluminium	14 Si 28.085 Silicon	15 P 30.973761998 Phosphorus	16 S 32.06 Sulfur	17 Cl 35.45 Chlorine	18 Ar 39.948 Argon	19 K 39.0983 Potassium	20 Ca 40.078 Calcium	21 Sc 44.955908 Scandium	22 Ti 47.867 Titanium	23 V 50.9415 Vanadium	24 Cr 51.9961 Chromium	25 Mn 54.938044 Manganese	26 Fe 55.845 Iron	27 Co 58.933194 Cobalt	28 Ni 58.6934 Nickel	29 Cu 63.546 Copper	30 Zn 65.38 Zinc	31 Ga 69.723 Gallium	32 Ge 72.630 Germanium	33 As 74.921595 Arsenic	34 Se 78.971 Selenium	35 Br 79.904 Bromine	36 Kr 83.798 Krypton	37 Rb 85.4678 Rubidium	38 Sr 87.62 Strontium	39 Y 88.90584 Yttrium	40 Zr 91.224 Zirconium	41 Nb 92.90637 Niobium	42 Mo 95.95 Molybdenum	43 Tc 98 Technetium	44 Ru 101.07 Ruthenium	45 Rh 102.90550 Rhodium	46 Pd 106.42 Palladium	47 Ag 107.8682 Silver	48 Cd 112.414 Cadmium	49 In 114.818 Indium	50 Sn 118.710 Tin	51 Sb 121.760 Antimony	52 Te 127.60 Tellurium	53 I 126.90447 Iodine	54 Xe 131.293 Xenon	55 Cs 132.90545196 Caesium	56 Ba 137.327 Barium	57 La 138.90547 Lanthanum	58 Ce 140.116 Cerium	59 Pr 140.90766 Praseodymium	60 Nd 144.242 Neodymium	61 Pm 145 Promethium	62 Sm 150.36 Samarium	63 Eu 151.964 Europium	64 Gd 157.25 Gadolinium	65 Tb 158.92535 Terbium	66 Dy 162.500 Dysprosium	67 Ho 164.93033 Holmium	68 Er 167.259 Erbium	69 Tm 168.93422 Thulium	70 Yb 173.054 Ytterbium	71 Lu 174.9668 Lutetium	72 Hf 178.49 Hafnium	73 Ta 180.94788 Tantalum	74 W 183.84 Tungsten	75 Re 186.207 Rhenium	76 Os 190.23 Osmium	77 Ir 192.217 Iridium	78 Pt 195.084 Platinum	79 Au 196.966569 Gold	80 Hg 200.592 Mercury	81 Tl 204.38 Thallium	82 Pb 207.2 Lead	83 Bi 208.98040 Bismuth	84 Po 209 Polonium	85 At 210 Astatine	86 Rn 222 Radon	87 Fr 223 Francium	88 Ra 226 Radium	89 Ac 227 Actinium	90 Th 232.0377 Thorium	91 Pa 231.03588 Protactinium	92 U 238.02891 Uranium	93 Np 237 Neptunium	94 Pu 244 Plutonium	95 Am 243 Americium	96 Cm 247 Curium	97 Bk 247 Berkelium	98 Cf 251 Californium	99 Es 252 Einsteinium	100 Fm 257 Fermium	101 Md 258 Mendelevium	102 No 259 Nobelium	103 Lr 266 Lawrencium	104 Rf 267 Rutherfordium	105 Db 268 Dubnium	106 Sg 269 Seaborgium	107 Bh 270 Bohrium	108 Hs 269 Hassium	109 Mt 278 Meitnerium	110 Ds 281 Darmstadtium	111 Rg 281 Roentgenium	112 Cn 285 Copernicium	113 Uut 286 Ununtrium	114 Fl 289 Flerovium	115 Uup 289 Ununpentium	116 Lv 293 Livermorium	117 Uus 294 Ununseptium	118 Uuo 294 Ununoctium	119 Uuh 294 Ununhennium	120 Uuq 294 Ununquadium	121 Uub 294 Ununbium	122 Uut 294 Ununtrium	123 Uuq 294 Ununquadium	124 Uub 294 Ununbium	125 Uut 294 Ununtrium	126 Uuq 294 Ununquadium	127 Uub 294 Ununbium	128 Uut 294 Ununtrium	129 Uuq 294 Ununquadium	130 Uub 294 Ununbium	131 Uut 294 Ununtrium	132 Uuq 294 Ununquadium	133 Uub 294 Ununbium	134 Uut 294 Ununtrium	135 Uuq 294 Ununquadium	136 Uub 294 Ununbium	137 Uut 294 Ununtrium	138 Uuq 294 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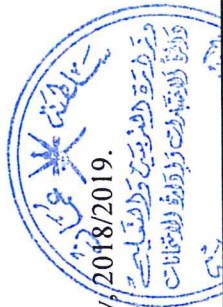
# MARKING GUIDE



## GENERAL EDUCATION DIPLOMA BILINGUAL PRIVATE SCHOOLS SEMESTER ONE - SECOND SESSION

### CHEMISTRY

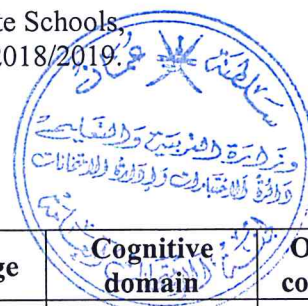
2018 / 2019



**Detailed Exam: Specifications for Semester One:**

Topics of the units	Weighting %	Multiple choice (20%)		Extended response (80%)		Cognitive levels			Total
		No. of Items	Marks	No. of questions	Marks	Knowing (30%)	Applying (50%)	Reasoning (20%)	
An introduction to the chemistry of transition elements	22%	3	3	10	12	5	7	3	15
Arenes and phenols	18%	3	3		10	4	7	2	13
Carboxylic acids and derivatives	20%	3	3		11	4	7	3	14
Nitrogen compounds	22 %	3	3		12	5	7	3	15
Polymerization	18%	2	2		11	4	7	2	13
<b>Total</b>	<b>100%</b>	<b>14</b>	<b>14</b>		<b>56</b>	<b>22</b>	<b>35</b>	<b>13</b>	<b>70</b>





**Distribution of cognitive domains and marks.**

Serial. No	Question Number	Item	Mark	Unit	Page	Cognitive domain	Out-comes
1	1	1	1	Transition elements	403	Knowing	1.3b.i
2	1	2	1	Transition elements	399-408	Applying	1.3a+ 1.3bi
3	1	3	1	Transition elements	403	Applying	1.3a+ 1.3bi
4	1	4	1	Arenes and phenols	423	Knowing	2.1.d.i
5	1	5	1	Arenes and phenols	423	Applying	2.1eiii
6	1	6	1	Arenes and phenols	426	Applying	2.1diii
7	1	7	1	Carboxylic acids and derivatives	443-444	Knowing	3.2c,b, c,e
8	1	8	1	Carboxylic acids and derivatives	444	Applying	3.2c
9	1	9	1	Carboxylic acids and derivatives	441	Reasoning	3.1c,d
10	1	10	1	Nitrogen compounds	452	Knowing	4.1ai
11	1	11	1	Nitrogen compounds	458	Applying	4.1a
12	1	12	1	Nitrogen compounds	458	Reasoning	4.1a
13	1	13	1	Polymerization	476	Applying	5.3d
14	1	14	1	Polymerization	474	Reasoning	5.3c



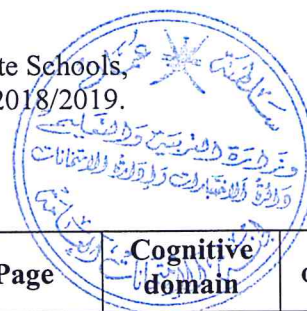
Serial. No	Question Number	Item	Mark	Unit	Page	Cognitive domain	Output
	2	15.a	1	Transition elements	399	Knowing	1.2c
	2	15.b	1	Transition elements	404	Knowing	1.3bii
	2	15.c(i)	1	Transition elements	403	Knowing	1.3bi
	2	15.c(ii)	1	Transition elements	403+ 408	Knowing	1.3bi
	2	15.d(i)	1	Transition elements	399+ 403	Applying	1.2a+ 1.3a
	2	15.d(ii)	1	Transition elements	403+ 408	Applying	1.3bi
	2	15.e	2	Transition elements	403	Applying	1.3a+ 1.3bi
	2	15.f	1	Transition elements	398-399	Applying	1.2b, d
	2	15.g(i)	1	Transition elements	398-399	Applying	1.3bii
	2	15.g(ii)	2	Transition elements	404	Reasoning	1.3a+ 1.3bi
	2	16.a	1	Arenes and phenols	418	Knowing	2.1c
	2	16.b	1	Arenes and phenols	426	Knowing	2.1ei
	2	16.c	1	Arenes and phenols	426	Knowing	2.1eiii
	2	16.d	1	Arenes and phenols	430	Applying	2.1div
	2	16.e	1	Arenes and phenols	421	Applying	2.1b
	2	16.f(i)	1	Arenes and phenols	424+ 429	Reasoning	2.1g
	2	16.f(ii)	2	Arenes and phenols	424+ 429	Reasoning	2.1g
	2	17	3	Arenes and phenols	420+ 421	Applying	2.1c





Serial. No	Question Number	Items	Mark	Unit	Page	Cognitive domain	outcome
	2	18.a	1	Carboxylic acids and derivatives	441	Knowing	3.1c
	2	18.b(i)	1	Carboxylic acids and derivatives	441	Applying	3.1ai
	2	18.b(ii)	1	Carboxylic acids and derivatives	443-447	Applying	3.2c
	2	18.b(iii)	1	Carboxylic acids and derivatives	443-447	Applying	3.2c
	2	18.c	2	Carboxylic acids and derivatives	443	Reasoning	3.1d
	2	19.a	2	Carboxylic acids and derivatives	443	Knowing	3.2a
	2	19.b	1	Carboxylic acids and derivatives	444	Applying	3.2c
	2	19.c	2	Carboxylic acids and derivatives	444	Applying	3.2c
	2	20.a	1	Nitrogen compounds	453	Knowing	4.1c
	2	20.b	2	Nitrogen compounds	456	Knowing	4.1dii
	2	20.c	1	Nitrogen compounds	464	Knowing	4.2f
	2	21.a	1	Nitrogen compounds	459	Applying	4.2a
	2	21.b(i)	2	Nitrogen compounds	460	Applying	4.2ci
	2	21.b(ii)	1	Nitrogen compounds	460	Applying	4.2cii
	2	21.c(i)	2	Nitrogen compounds	459	Applying	4.2c
	2	21.c(ii)	2	Nitrogen compounds	453-459	Reasoning	4.1c+ 4.2b

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Semester One, Second Session, Chemistry, 2018/2019.

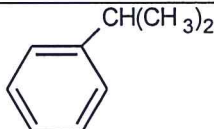
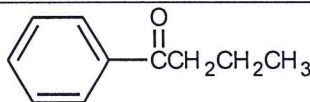
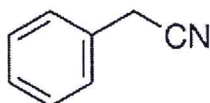
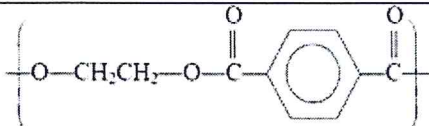


Serial. No	Question Number	Items	Mark	Unit	Page	Cognitive domain	outcome
	2	22.a(i)	1	Polymerization	476	Applying	5.3d
	2	22.a(ii)	1	Polymerization	475	Applying	5.3c
	2	22.b(i)	1	Polymerization	474	Applying	5.2b
	2	22.b(ii)	1	Polymerization	470	Applying	5.2a
	2	22.c	1	Polymerization	470	Knowing	5.1b
	2	22.d	1	Polymerization	475	Applying	5.3a
	2	22.e	1	Polymerization	475	Knowing	5.3b
	2	22.f	1	Polymerization	475	Applying	5.3a
	2	23.a	1	Polymerization	476-477	Knowing	5.1b
	2	23.b	1	Polymerization	476-477	Knowing	5.3bii
	2	23.c	1	Polymerization	476	Reasoning	5.3d



**Question ONE TOTAL MARKS: 14**

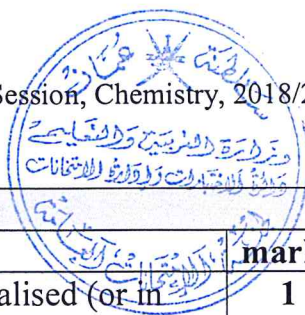
**There are 14 multiple-choice items. Each correct answer is worth ONE mark.**

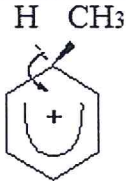
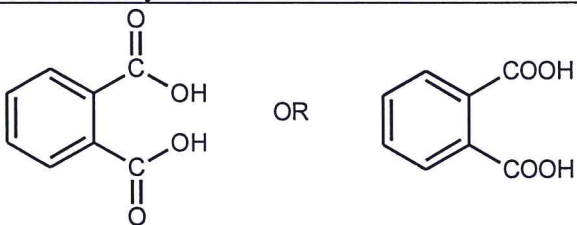
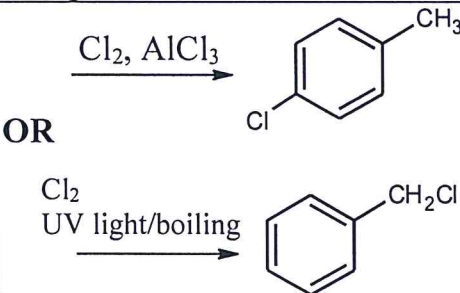
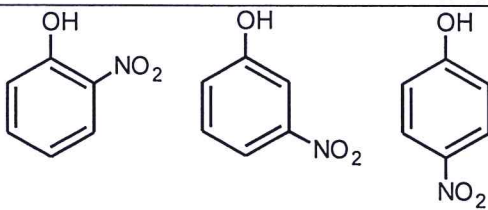
Item No.	Correct option		
1	a coordinate covalent bond		
2	Six dative covalent bonds are formed in this complex ion.		
3	The complex formed when the ligands are attracted to the metal ions.		
4	It is an electrophilic addition reaction.		
5			
6			
7	They react with alcohols to produce esters		
8	NaOH		
9	D < B < A < C.		
10	white crystalline solid		
11			
12	HNO <sub>3</sub> , H <sub>2</sub> SO <sub>4</sub>	Sn , HCl	NaOH
13	4		
14			

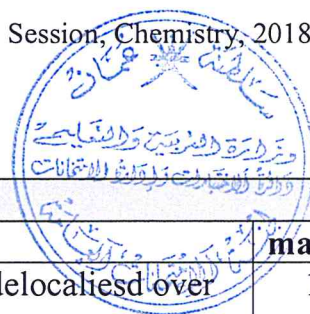


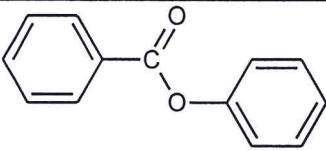
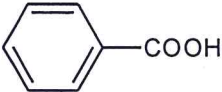
**Question TWO: TOTAL MARKS: 56**

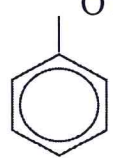
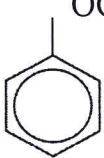
Item 15		Total marks 12
item	answer	marks
15	a Cobalt / Co	1
	b Octahedral	1
	c(i) - Ligands are bases, and also nucleophiles. - They contain lone pair of electrons to bond to the metal to form complex ion. <b>Any answer from above mark is given.</b>	1
	c(ii) - Because the ligands (NH <sub>3</sub> ) join by one bond to the metal ion (Co <sup>3+</sup> ). - Because the ligands (NH <sub>3</sub> ) are attached by one coordinate bond to the metal ion (Co <sup>3+</sup> ). - Because the ligands (NH <sub>3</sub> ) contain one group that has a lone pair of electrons. <b>Any answer from above mark is given.</b>	1
	d(i) Co <sup>3+</sup>	1
	d(ii) NH <sub>3</sub>	1
	e 6 / six (1 mark) Because each dative bond (co-ordinate bond) is formed between each ligand (NH <sub>3</sub> ) and the metal ion Co <sup>3+</sup> . - Because there are 6 monodentate ligand (NH <sub>3</sub> ) in the complex ion. - Because the number of atoms surrounding the central atom (Co) is 6. - Because the complex ion has 6 pairs of electrons. <b>Any answer from above mark is given. (1 mark)</b>	2
	f [Ar]3d <sup>6</sup>	1
	g(i) Tetrahedral	1
	g(ii) First complex ion (1 mark) Because the ligand (NH <sub>3</sub> ) is stronger than the ligand (H <sub>2</sub> O). - More nucleophilic so the donation of pairs of electrons to the metal will be more and so they will form stronger co-ordinate bonds. - The strength of attraction of the ligand NH <sub>3</sub> is much more than that of H <sub>2</sub> O so it will form stable complex ion because it forms strong bond to the metal ion. - Because there is an additional entropy effect that adds to their stability. - Because the ligand NH <sub>3</sub> will increase the entropy. (1mark) <b>Any answer from above mark is given.</b>	2



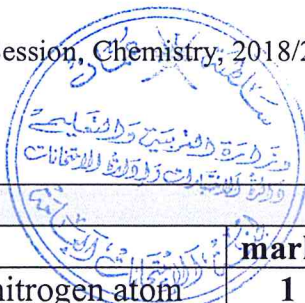
Item 16		Total marks 7
item	answer	marks
16	<b>a</b> - Because the $\pi$ electrons (or double bonds) are delocalised (or in resonance). - Electrons are evenly distributed. <b>Any answer from above mark is given.</b>	1
	<b>b</b> - It introduces a permanent dipole on $\text{CH}_3\text{Cl}$ molecule to form $\text{CH}_3^+$ - $\text{AlCl}_3 + \text{CH}_3\text{Cl} \rightarrow \text{AlCl}_4^- + \text{CH}_3^+$ - $\text{AlCl}_3 + \text{CH}_3\text{Cl} \rightarrow \text{CH}_3^{\delta+} - \text{AlCl}_4^{\delta-}$ <b>Any answer from above mark is given.</b>	1
	<b>c</b> 	1
	<b>d</b> 1,2-dimethylbenzene	1
	<b>e</b> 	1
	<b>f(i)</b> Using the reagent and condition (or $\text{Cl}_2$ , UV light) will not produce that product	1
	<b>f(ii)</b>  - using $\text{Cl}_2$ , $\text{AlCl}_3$ will produce the product (4-chloromethylbenzene) - using $\text{Cl}_2$ , UV light/boiling will produce (chloromethyl)benzene <b>Any answer from above mark is given.</b>	1
Item 17		Total marks 3
item	answer	marks
17	 3 marks: 1 mark for each compound	3

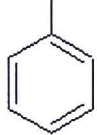


Item 18		Total marks 6
item	answer	marks
18	<p>a</p> <p>- Because the negative charge on the anion can be delocalised over two electronegative oxygen atoms.</p> <p>- Because carboxylic acids are stronger acids than alcohols.</p> <p><b>Any answer from above mark is given.</b></p>	1
	<p>b(i)</p> <p><math>\text{CH}_3\text{CH}_2\text{COO}^-\text{Na}^+</math></p>	1
	<p>b(ii)</p> 	1
	<p>b(iii)</p> 	1
	<p>c</p> <p>D (1 mark)</p> <p>Because the electronegativity of the oxygen and the easily polarized C=O double bond, have a dramatic effect on the reactivity (1 mark)</p>	2

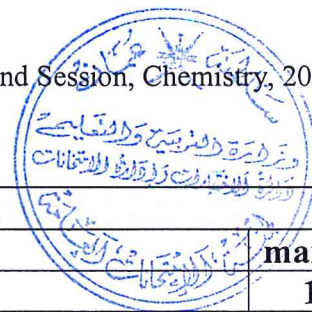
Item 19		Total marks 5
item	answer	marks
19	<p>a</p> <p>Are liquid, fume in moist air, immiscible with water, react slowly with water, eventually dissolve, they are not hydrogen bonded, (full marks for any two answers ). <b>Any other correct property mark is given.</b></p>	2
	<p>b</p> <p>Ester</p>	1
	<p>c</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> <p>X:</p>  </div> <div style="text-align: center;"> <p>Y:</p>  </div> </div> <p>Each answer worth 1 mark.</p>	2

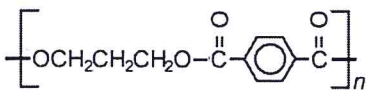


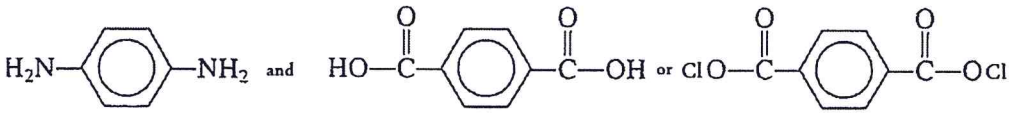


Item 20		Total marks 4
item	answer	marks
20 a	- Electron-donating alkyl groups ( $\text{CH}_3$ ) attached to the nitrogen atom increase the basicity of amine ( $\text{CH}_3\text{CH}_2\text{CH}_2\text{NH}_2$ ). - Electron donation from an alkyl group (or $\text{CH}_3$ ) will encourage dative bond formation. <b>Any answer from above mark is given.</b>	1
b	<div style="text-align: center;"> <math>\text{N}_2\text{Cl}</math>   <math>+ 2\text{H}_2\text{O}</math> </div> $\text{C}_6\text{H}_5\text{N}\equiv\text{NCl} + 2\text{H}_2\text{O}$ or $\text{C}_6\text{H}_5\text{N}_2\text{Cl} + 2\text{H}_2\text{O}$ or 2 marks: Each product 1 mark	2
c	- Two or more amino acids can undergo condensation reaction between themselves. - By losing H from amine group and OH from carbonyl group. <b>Any answer from above mark is given.</b>	1

Item 21		Total marks 8
item	answer	marks
21 a(i)	$\text{CH}_3\text{CH}_2\text{NH}_2$	1
b(i)	<div style="text-align: center;"> <math>\text{H}_3\text{C}-\overset{\text{O}}{\parallel}\text{C}-\text{O}^- \text{Na}^+ + \text{CH}_3\text{CH}_2\text{NH}_2</math> </div> 2marks: each product 1 mark	2
b(ii)	<div style="text-align: center;"> <math>\text{H}_3\text{C}-\text{CH}_2-\text{NHCH}_2\text{CH}_3</math> </div>	1
c(i)	$\text{CH}_3\text{COOH} + ^+\text{NH}_3\text{CH}_2\text{CH}_3$ 2marks: each product 1 mark	2
c(ii)	N-ethylethanamide (1 mark)  - Because in diethylamine, the electron-donating alkyl groups attached to the nitrogen atom increase the basicity. - In N-ethylethanamide the lone pair of electrons on nitrogen atom is less available. - In diethylamine the lone pair of electrons on nitrogen will be more available to form a dative bond with a proton. <b>Any answer from above mark is given. 1mark</b>	2



Item 22		Total marks 8
item	answer	marks
22	a(i) HOCH(CH <sub>3</sub> )COOH	1
	a(ii) 	1
	b(i) Condensation reaction	1
	b(ii) Addition reaction	1
	c Vander Waals forces	1
	d Water (H <sub>2</sub> O)	1
	e The direction of successive functional groups along the chain	1
	f Ester	1

Item 23		Total marks 3
item	answer	marks
23	a Hydrogen bonds	1
	b Type II	1
	c  1 mark: each monomer 1/2 mark	1

**This is the end of the Marking Guide**