سلطنة عمان
وزارة التربية والتعليم

مركز القياس والتقويم التربوي
The Center for Educational Assessment and Measurement (CEAM)

امتحان دبلوم التعليم العام
لكلية الحرس السلطاني العماني التقنية (ثنائية اللغة)
الفصل الدراسي الأول - الدور الأول - للعام الدراسي ١٤٤٧/١٤٤٦ هـ - ٢٠٢٤ / ٢٠٢٥ م

تنبيه:
- المادة: الكيمياء.
- الأسئلة في (١٤) صفحة.
- زمن الإجابة: ثلاث ساعات.
- الإجابة في الورقة نفسها.

تعليمات مهمة:

- يجب الحضور إلى قاعة الامتحان قبل عشر دقائق على الأقل من بدء زمن الامتحان.
- يجب إحضار أصل ما يثبت الهوية وإبرازها للعاملين بالامتحانات.
- يجب الالتزام بالزي (الدشداشة البيضاء والمصر أو الكمة للذكور) والزي المدرسي للطالبات ، ويستثنى من ذلك الدارسون من غير العمانيين بشرط الالتزام بالذوق العام، ويمنع على جميع المتقدمات ارتداء النقاب داخل المركز وقاعات الامتحان.
- يحظر على الممتحنين اصطحاب الهواتف النقالة وأجهزة النداء الآلي وآلات التصوير والحواسيب الشخصية والساعات الرقمية الذكية والآلات الحاسبة ذات الصفة التخزينية والمجلات والصحف والكتب الدراسية والدفاتر والمذكرات والحقائب اليدوية والآلات الحادة أو الأسلحة أياً كان نوعها وأي شيء له علاقة بالامتحان.
- يجب على الممتحن الامتثال لإجراءات التفتيش داخل المركز طوال أيام الامتحان.
- 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.

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 one mark each.

Shade in the bubble (⬭) next to the **correct** answer for each item.

1) What is the conjugate base for the following reaction?

$$CH_3OH(aq) + NH_2^-(aq) \rightleftharpoons CH_3O^-(aq) + NH_3(aq)$$

⬭ NH_2^- ⬭ NH_3

⬭ CH_3O^- ⬭ CH_3OH

2) What is the pH of a solution that contains 0.211 mol dm^{-3} acetic acid (CH_3COOH) and 0.172 mol dm^{-3} sodium acetate (CH_3COONa)?

(K_a of acetic acid = 1.76 x 10^{-5})

⬭ 2.16 ⬭ 4.66

⬭ 4.84 ⬭ 9.32

3) Which of the following acids is the strongest?

	Acid (con. 0.1 mol dm^{-3})	K_a at 25°C(mol dm^{-3})
⬭	HX	1.5×10^{-2}
⬭	HY	4.7×10^{-4}
⬭	HZ	1.7×10^{-5}
⬭	HW	1.3×10^{-5}

4) Which is the correct expression for the solubility product constant, K_{sp}, for (Au_3PO_4)?

⬭ $K_{sp} = [Au^+]^3 [PO_4^{3-}]$ ⬭ $K_{sp} = [Au^+][PO_4^{3-}]^3$

⬭ $K_{sp} = [Au^+][PO_4^{3-}]$ ⬭ $K_{sp} = [Au^+]^3 [PO_4^{3-}]^3$

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Question 1 continued

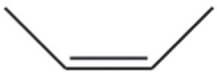
5) Which of the following pairs will show a common ion effect?

- ☐ HCl, NaCl
- ☐ NaOH, NaCl
- ☐ Na_2SO_4, $CaSO_4$
- ☐ H_2CO_3, Na_2CO_3

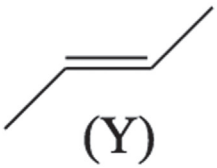
6) Which is the correct general formula for the following classes of compound?

	Classes of compound	General formulae
☐	alcohols	$C_nH_{2n+1}OH$
☐	aldehydes	$C_nH_{2n+1}CHO$
☐	primary amines	$C_nH_{2n+1}NH$
☐	esters	$C_nH_{2n+1}COOC_mH_{2m}$

7) What allows the two structures of (X) and (Y) to be geometrically cis and trans isomers?



(X)



(Y)

- ☐ The two molecules have different functional groups.
- ☐ The two molecules are a mirror image of one another.
- ☐ The double bond restricts the rotation of carbon atoms.
- ☐ Functional groups are located at different positions on the chain.

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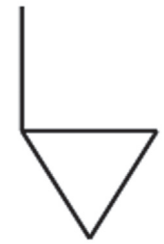
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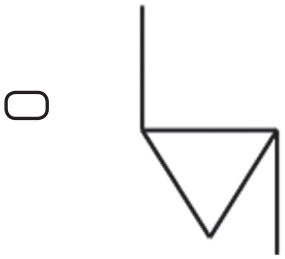
8) What is the IUPAC name for this compound?

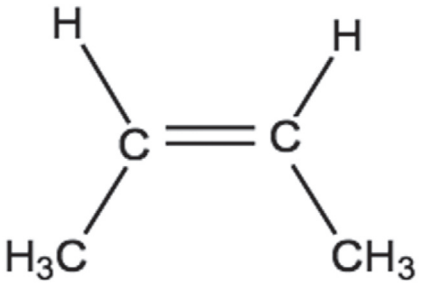
$CH_3CH_2CH(F)C(CH_3)_2CH_3$

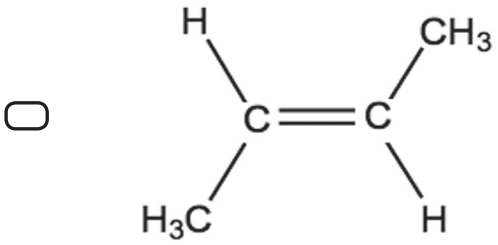
- ☐ 2,2-dimethyl-3-fluoropentane
- ☐ 3-fluoro-2,2-dimethylpentane
- ☐ 4,4-dimethyl-3-fluoropentane
- ☐ 3-fluoro-4,4-dimethylpentane

9) Which of the following molecules is a chiral?

☐ 

☐ 

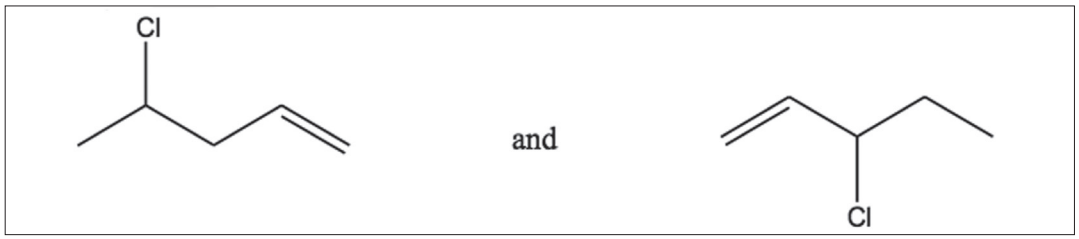
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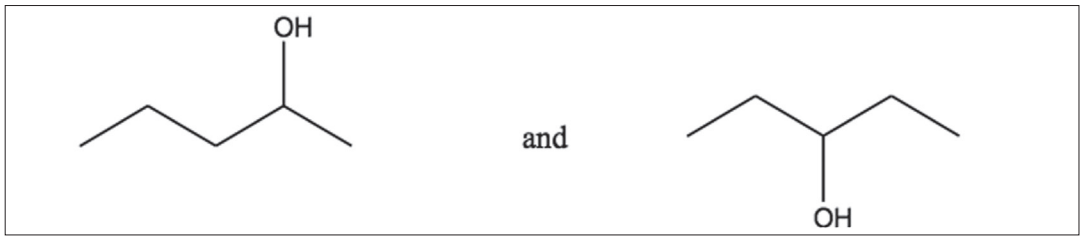
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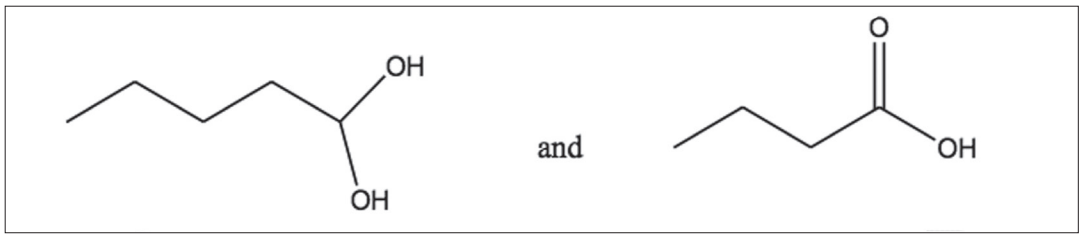
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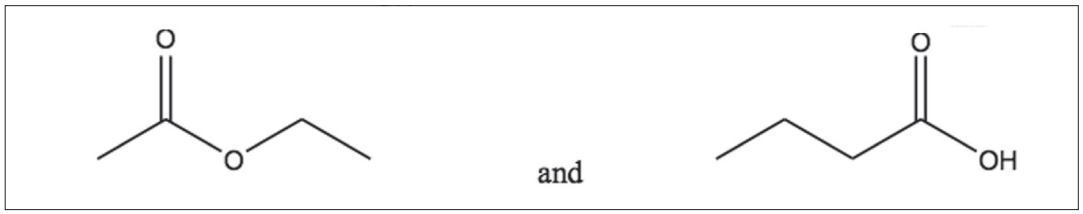
Question 1 continued

10) Which one is a pair of functional group isomers?

- ☐ 

- ☐ 

- ☐ 

- ☐ 

11) Which statement is correct for the following reaction mechanism?

$$CH_2{=}CH_2 + Br_2 \longrightarrow CH_2BrCH_2Br$$

- ☐ Br^- acts as a nucleophile.
- ☐ The double bond has an electron deficiency.
- ☐ The double bond attracts the electrons in the bromine.
- ☐ This mechanism is also known as a nucleophilic addition.

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Question 1 continued

12) Which of the following compounds is a secondary halogenoalkane?

- ☐ $CHCl_3$
- ☐ $(CH_3)_2CHCl$
- ☐ $(CH_3)_2CHCH_2Cl$
- ☐ $(CH_3)_2CClCH_2CH_3$

13) What is substance (X) for the following reaction?

2-pentene + (X) ⟶ 2,3-dichloropentane

- ☐ Chlorine
- ☐ Sodium chloride
- ☐ Chlorine dioxide
- ☐ Hydrochloric acid

14) The following table shows the length of 4 different carbon-halogen bonds:

Bond symbol	Bond length (A)
R-M	2.14
R-Y	1.93
R-Z	1.78
R-W	1.39

Which compound will be the **first** to produce a precipitate when mixed with aqueous silver nitrate in ethanol?

- ☐ R-M
- ☐ R-Y
- ☐ R-Z
- ☐ R-W

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Question 2: Extended Responses (56 marks)

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) An aqueous solutions contains 5.00g of nitric acid (HNO_3) per dm^3.

a. Write the general pH expression. (1 mark)

b. Nitric acid dissociates in water according to the equation below: (1 marks)

$$HNO_3(aq) + H_2O(l) \rightleftharpoons H^+(aq) + NO_3^-(aq)$$

Which one of the products is a conjugate base?

c. Answer the following questions, to calculate the pH of the solution.

(i) What is the number of moles in 5.00g of HNO_3? (2 mark)

(ii) What is the Molarity of the aqueous solution, HNO_3? (2 mark)

(iii) Calculate the pH of the solution. (1 mark)

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Question 2 continued

16) A weak acid, HA, has a concentration 0.106 mol dm^{-3} and a pH of (3.21).

a. Write the dissociation constant expression K_a of the weak acid (HA). (1 mark)

b. Calculate the $[H^+]$ of the acid (HA). (2 marks)

c. Calculate the K_a of the weak acid (HA). (3 marks)

17) Two salts, CuS(s) and CoS(s) are slightly soluble in water, knowing that the K_{sp} of the salts are in table below.

Salt	K_{sp} mol dm^{-3} (at 298K)
CuS	6.3×10^{-36}
CoS	2.0×10^{-26}

a. Write the solubility product K_{sp} expression for CoS. (1 mark)

b. Calculate the molar solubility for CoS(s). (3 mark)

c. Which salt has more solubility in water. (1 mark)

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Question 2 continued

18) Compound (X) has several isomers. The structure of (X) is:



a. What is the formula class of compound (X)? (1 mark)

b. Draw the displayed formulae of a chain isomer and a functional group isomer for compound (X). **(only two structures for each type)** (4 mark)

Type of isomer	Displayed formula	
Chain isomer		
Functional group isomer		

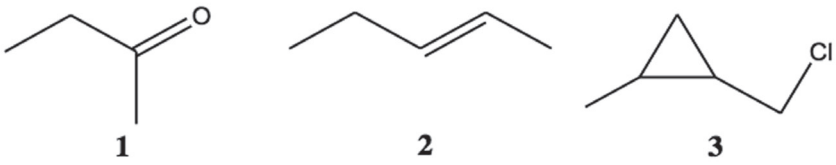
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Question 2 continued

19) Study the following compounds and answer the questions below:



1 2 3

a. Determine the type of functional group for:

(i) Compound (1): (1 mark)

_____

(ii) Compound (2): (1 mark)

_____

b. What type is the geometrical isomerism in Compound (2)? (1 marks)

_____

c. Compound (3) has a chiral center.

(i) What is meant by a chiral center? (1 marks)

_____

(ii) Draw a circle around the chiral center. (1 mark)

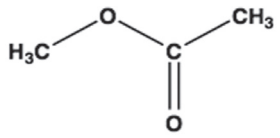
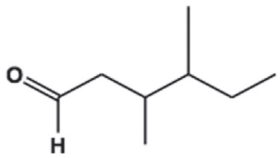
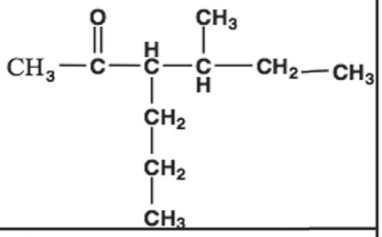
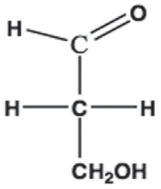
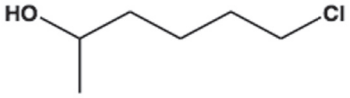
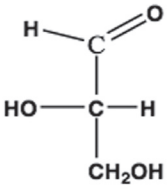
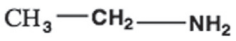
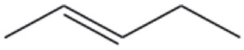
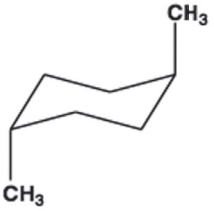


(iii) Draw one position isomer (**skeletal structure**) for compound (3). (1 mark)

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Question 2 continued

20) The table below shows several compounds.

A 	**B** 	**C** 
D 	**F** 	**J** 
H 	**I** 	**K** 

a. Write the IUPAC name of compound:

(i) (B): _____ (1 mark)

(ii) (F): _____ (1 mark)

b. Draw the skeletal formula of compound (C). (1 marks)

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Question 2 continued

c. Which compound has a functional group of:

(i) Ester: _____ (1 mark)

(ii) Amine: _____ (1 mark)

d. The molecular formula of Compound (I) is _____ (1 mark)

e. Explain, Compound (K) has trans geometrical isomerism: (1 mark)

_____

_____

f. Which compound is an optical isomer?

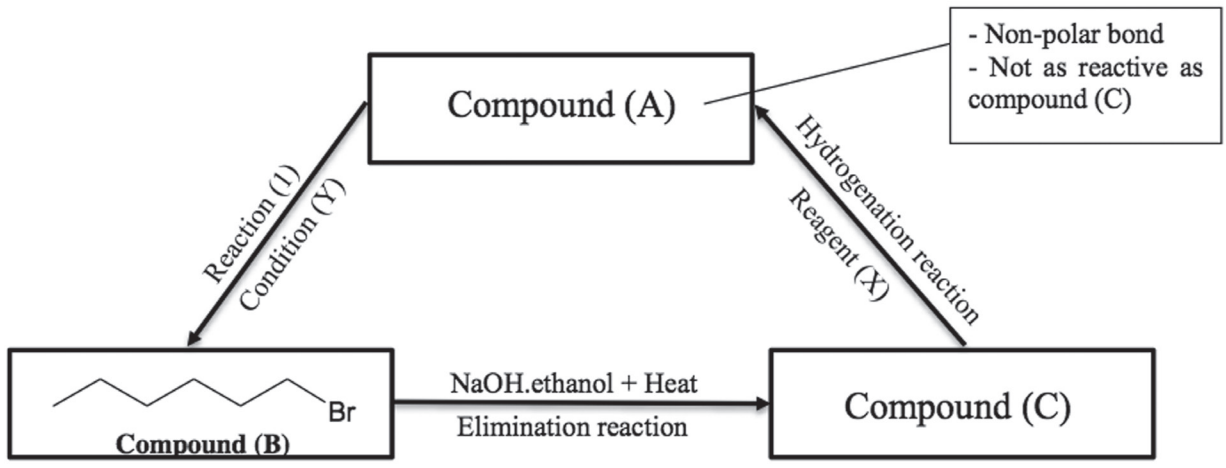
☐ D ☐ J **(shade your answer)**

Explain your answer. (2 mark)

_____

_____

21) Study the following scheme then answer the questions below:



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Question 2 continued

a. Draw the structural formula for:

(i) Compound (C): (1 mark)

(ii) Compound (A): (1 mark)

b. What is the reagent that is used to convert Compound (C) to Compound (A)?

Reagent (X): _____ (1 mark)

c. What is the type of reaction and the condition in which Compound (B) can be produced from Compound (A)?

(i) Reaction (1): _____ (1 mark)

(ii) Condition (Y): _____ (1 mark)

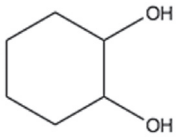
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Question 2 continued

22) The following oxidation reaction is used to test some hydrocarbons,

Compound (X) + H_2O + [O] ⟶ 

Knowing that a color change was detected while carrying out this reaction,

a. Predict the saturation of the hydrocarbon (X). (1 mark)

b. What is the oxidizing reagent that was used? (1 mark)

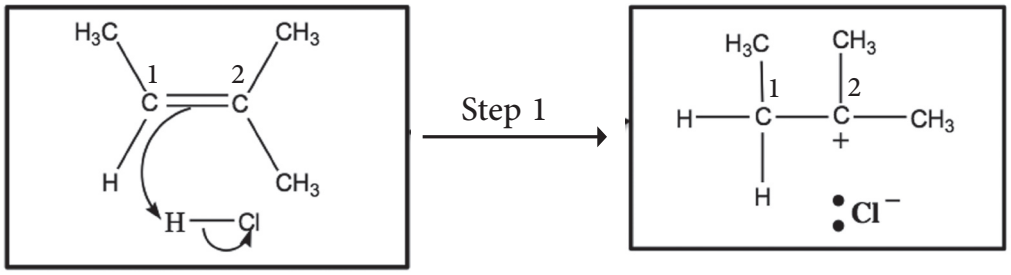
c. If compound (X) was replaced with butane, would you expect the oxidation reaction to take place? (1 mark)

d. State another way that is used to test such hydrocarbons. (1 mark)

23) The following chemical equation represents an electrophilic addition reaction:

$$CH_3CH{=}C(CH_3)_2 + HCl \longrightarrow CH_3CH_2CCl(CH_3)_2$$

Part of this reaction mechanism is shown below,



A B

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Question 2 continued

a. Determine the following:

(i) The intermediate: (1 mark)



(ii) The electrophile: _____ (1 mark)

(iii) The nucleophile: _____ (1 mark)

b. The (H) atom from HCl was added to carbon atom (1). Explain. (1 mark)

_____

24) A free-radical substitution reaction equation is shown below,

$$C_2H_6 + Cl_2 \longrightarrow C_2H_5Cl + HCl$$

a. Complete the table: (3 marks)

Steps	Reactants	Products
_____	Cl_2	$2Cl^{\bullet}$
Propagation	_____	$C_2H_5^{\bullet} + HCl$
_____	$C_2H_5^{\bullet} + C_2H_5^{\bullet}$	C_4H_{10}

b. Write **two reaction** equations which can eliminate free radicals from the system other than the one in the table. (2 marks)

_____

_____

_____

[End of the Examination]

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Periodic Table

1 H 1.01																	2 He 4.00
3 Li 6.941	4 Be 9.012											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.31											13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 40.00
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.88	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.38	31 Ga 69.72	32 Ge 72.59	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (98)	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3
55 Cs 132.9	56 Ba 137.3	57 La* 138.9	72 Hf 178.5	73 Ta 180.9	74 W 183.9	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra 226	89 Ac (227)															

Lanthanides	58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (145)	62 Sm 150.4	63 Eu 152.0	64 Gd 157.3	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0
Actinides	90 Th 232.0	91 Pa (231)	92 U 238	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (260)

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مركز القياس والتقويم التربوي
The Center for Educational Assessment and Measurement (CEAM)

سلطنة عمان
وزارة التربية والتعليم

MARKING GUIDE

GENERAL EDUCATION DIPLOMA

ROYAL GUARD OF OMAN TECHNICAL COLLEGE

SEMESTER ONE – FIRST SESSION

CHEMISTRY

2024 / 2025

General Education Diploma, Oman Royal Guard Technical College
Semester One, First Session, Chemistry, 2024/2025.

Detailed Exam Specifications for Semester One:

Topics of the units	Weighting %	Multiple choice (20%)					Extended response (80%)					Total marks
		No. of Questions	Marks	Cognitive levels			No. of questions	Marks	Cognitive levels			
				Knowing (30%)	Applying (50%)	Reasoning (20%)			Knowing (30%)	Applying (50%)	Reasoning (20%)	
Quantitative equilibrium	33%	14	5	1	3	1	10	18	6	9	3	23
Introduction to Organic Chemistry	36%		5	2	2	1		20	6	10	4	25
Hydrocarbons and Halogenoalkanes	31%		4	1	2	1		18	5	9	4	22
Total	100%		14	4	7	3		56	17	28	11	70

General Education Diploma, Oman Royal Guard Technical College,
Semester One, First Session, Chemistry, 2024/2025.

Distribution of cognitive domains and marks.

QUESTION ONE: Multiple choice (14 marks)

Item	Mark	Unit	Cognitive domain	Output	Page
1	1	Quantitative equilibrium	Knowing	a	9
2	1	Quantitative equilibrium	Applying	j	30
3	1	Quantitative equilibrium	Applying	c	18-19
4	1	Quantitative equilibrium	Applying	m	36
5	1	Quantitative equilibrium	Reasoning	o	40-41
6	1	Introduction to Organic Chemistry	Knowing	2.1 a	42-62
7	1	Introduction to Organic Chemistry	Knowing	2.2 c	42-62
8	1	Introduction to Organic Chemistry	Applying	2.1 b	42-62
9	1	Introduction to Organic Chemistry	Reasoning	2.2 e	42-62
10	1	Introduction to Organic Chemistry	Applying	2.2 a	42-62
11	1	Hydrocarbons and Halogenoalkanes	Knowing	3.2.c	78
12	1	Hydrocarbons and Halogenoalkanes	Applying	3.3.b	85
13	1	Hydrocarbons and Halogenoalkanes	Applying	3.2.b.i	73
14	1	Hydrocarbons and Halogenoalkanes	Reasoning	3.3.c.iv	88-90

QUESTION TWO: Extended response (56 marks)

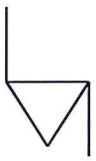
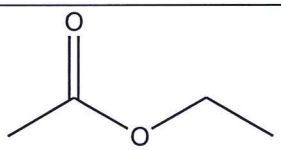
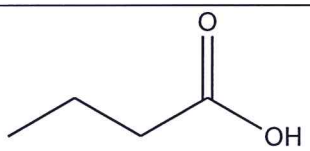
Item	Mark	Unit	Cognitive domain	Output	Page
15 a	1	Quantitative equilibrium	Knowing	c	10
15 b	1	Quantitative equilibrium	Applying	a, b	8-10
15 c (i)	2	Quantitative equilibrium	Knowing + Applying	d	34
15 c (ii)	2	Quantitative equilibrium	Knowing + Applying	d	34
15 c (iii)	1	Quantitative equilibrium	Applying	d	10-13
16 a	1	Quantitative equilibrium	Knowing	c	18-19
16 b	2	Quantitative equilibrium	Knowing + Applying	c, d	12-13
16 c	3	Quantitative equilibrium	Knowing + 2 Applying	c	20-21
17 a	1	Quantitative equilibrium	Applying	m	35-36
17 b	3	Quantitative equilibrium	1 Applying + 2 Reasoning	n	37-39
17 c	1	Quantitative equilibrium	Reasoning	I	35-36
18 a	1	Introduction to Organic Chemistry	Knowing	2.1a	42-62
18 b	4	Introduction to Organic Chemistry	Applying	2.1 a 2.2 f	42-62
19 a (i)	1	Introduction to Organic Chemistry	Knowing	2.1 a	42-62
19 a (ii)	1	Introduction to Organic Chemistry	Knowing	2.1 a	42-62
19 b	1	Introduction to Organic Chemistry	Applying	2.2 c	42-62
19 c (i)	1	Introduction to Organic Chemistry	Knowing	2.2 d	42-62
19 c (ii)	1	Introduction to Organic Chemistry	Reasoning	2.2 d	42-62
19 c (iii)	1	Introduction to Organic Chemistry	Reasoning	2.2 f	42-62
20 a (i)	1	Introduction to Organic Chemistry	Applying	2.1 a	42-62
20 a (ii)	1	Introduction to Organic Chemistry	Applying	2.1 a	42-62
20 b	1	Introduction to Organic Chemistry	Applying	2.1 a	42-62
20 c (i)	1	Introduction to Organic Chemistry	Knowing	2.1 a	42-62
20 c (ii)	1	Introduction to Organic Chemistry	Knowing	2.1 a	42-62

d	1	Introduction to Organic Chemistry	Applying	2.1 c	42-62
e	1	Introduction to Organic Chemistry	Applying	2.2 b	42-62
f	2	Introduction to Organic Chemistry	Reasoning	2.2 d	42-62
21 a(i)	1	Hydrocarbons and Halogenoalkanes	Applying	3.2 a.i	70-71
21 a(ii)	1	Hydrocarbons and Halogenoalkanes	Reasoning	3.1 a.i	66
21 b	1	Hydrocarbons and Halogenoalkanes	Knowing	3.1 a.i	66
21 c(i)	1	Hydrocarbons and Halogenoalkanes	Reasoning	3.3 a.i	82
21 c(ii)	1	Hydrocarbons and Halogenoalkanes	Reasoning	3.3 a.i	82
22 a	1	Hydrocarbons and Halogenoalkanes	Reasoning	3.2 b.ii	75-77
22 b	1	Hydrocarbons and Halogenoalkanes	Knowing	3.2 b.ii	75-77
22 c	1	Hydrocarbons and Halogenoalkanes	Applying	3.1 d	69
22 d	1	Hydrocarbons and Halogenoalkanes	Knowing	3.1 d	75-77
23 a(i)	1	Hydrocarbons and Halogenoalkanes	Applying	3.3 a.ii	83
23 a(ii)	1	Hydrocarbons and Halogenoalkanes	Applying	3.3 a.ii	83
23 a(iii)	1	Hydrocarbons and Halogenoalkanes	Applying	3.3 a.ii	83
23 b	1	Hydrocarbons and Halogenoalkanes	Applying	3.3 a.ii	83
24 a	3	Hydrocarbons and Halogenoalkanes	2 Knowing + 1 Applying	3.1 c	68-69
24 b	2	Hydrocarbons and Halogenoalkanes	Applying	3.1 c	68-69

General Education Diploma, Oman Royal Guard Technical College
Semester One, First, Chemistry, 2024/2025.

TOTAL MARKS: 70 **PAGES: 6**

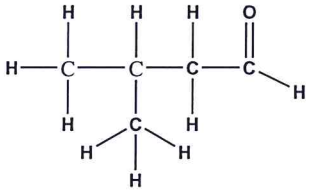
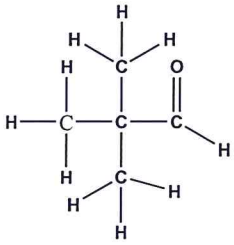
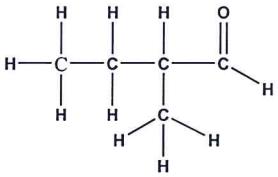
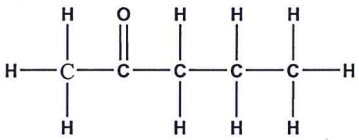
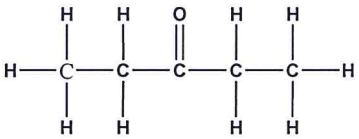
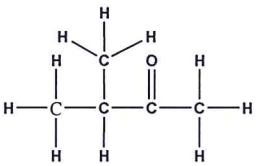
Question One (14 Marks)
There are 14 multiple-choice items. Each correct answer is worth ONE mark.

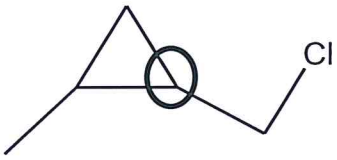
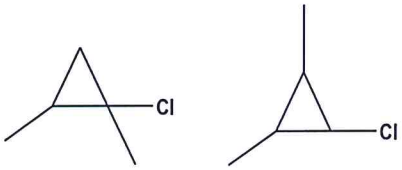
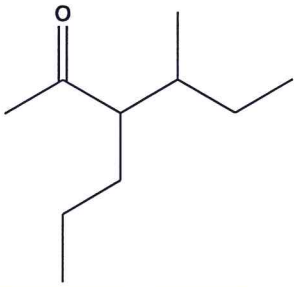
Item	Correct option	
1	c	CH_3O^-
2	b	4.66
3	a	HX | 1.5×10^{-2}
4	a	$K_{sp} = [Au^+]^3[PO_4^{3-}]$
5	c	Na_2SO_4, $CaSO_4$
6	a	alcohols | $C_nH_{2n+1}OH$
7	c	The double bond restricts the rotation of carbon atoms.
8	b	3-fluoro-2,2-dimethylpentane.
9	b	 (b)
10	d	 and 
11	a	Br^- acts as a nucleophile.
12	b	$(CH_3)_2CHCl$
13	a	Chlorine
14	a	R-M

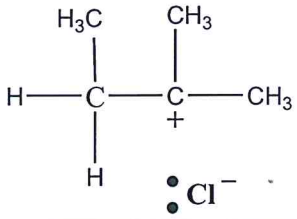
Question Two (56 Marks)

Part	Section	The answer	The mark
15	a	$pH = -\log_{10}[H^+]$	1
	b	$NO_3^-{}_{(aq)}$	1
	c (i)	1 mole of (HNO_3) = 63.02g (RFM) Number of moles of (HNO_3) in (5.00g), mass/RFM= **5.00g/63.02g** per 1mol **= 0.0793 mol** another way: 1mol ↔ 63.02g xmol ↔ 5g x = 5/63.02 = **0.0793 mol**	1 1
	c (ii)	Molarity of aqueous solution, $HNO_{3(aq)}$, (M = mol/V dm^3) M = **0.0793 mol/1dm^3** = 0.0793 mol dm^{-3} M = **0.0793 M**(molar)	1 1
	c (iii)	HNO_3 is a strong acid, so it is fully ionized in water. The equilibrium lies far to the right: $HNO_{3(aq)} \rightarrow H^+_{(aq)} + NO_3^-{}_{(aq)}$ 0.0793 M → 0.0793 M $pH = -\log_{10}[H^+]$ $pH = -\log_{10}(0.0793)$ = **1.10**	1

Part	Section	The answer	The mark
16	a	The general equation of a weak acid is: $HA_{(aq)} \leftrightharpoons H^+_{(aq)} + A^-_{(aq)}$ The acid dissociation constant, $\mathbf{K_a = [H^+][A^-]/[HA]}$ **Or.** When 1 mole of HA ionizes, we get 1mol H^+ and 1mol A^-, therefore $[H^+]= [A^-]$. So, $\mathbf{K_a = [H^+]^2/[HA]}$	1
	b	$pH= -\log_{10}[H^+]$, so $\mathbf{[H^+]= 10^{-pH}}$ $[H^+] = (10^{-3.21})$ $[H^+] = \mathbf{6.17\times10^{-4}\ mol\ dm^{-3}}$	1 1
	c	$\mathbf{K_a= [H^+]^2/[HA]}$ $\mathbf{K_a= (10^{-pH})^2/[HA]}$ $K_a= (10^{-3.21})^2/ 0.106\ mol\ dm^{-3}$ $\mathbf{k_a= (6.17\times10^{-4}\ mol\ dm^{-3})^2/0.106\ mol\ dm^{-3}}$ $k_a = 3.82\times10^{-7}\ mol^2\ dm^{-6}/0.106\ mol\ dm^{-3}$ $\mathbf{k_a= 3.59\times10^{-6}\ mol\ dm^{-3}}$	1 1 1
17	a	$CoS_{(s)} \leftrightharpoons Co^{2+}_{(aq)} + S^{2-}_{(aq)}$ $\mathbf{K_{sp}\ CoS_{(s)} = [Co^{2+}][S^{2-}]}$	1
	b	$K_{sp}\ CoS_{(s)} = [Co^{2+}][S^{2-}]$ $K_{sp} = (x)(x) = (x)^2$ $\mathbf{2.0\times10^{-26}= (x)^2}$ $\mathbf{x = \sqrt{2.0\times10^{-26}}}$ $\mathbf{x= 1.41\times10^{-13}\ mol\ dm^{-3}}$	1 1 1
	c	CoS(s)	1

Part	Section	The answer	The mark
18	a	Skeletal formula	1
	b	Type of isomer: Chain isomer Displayed formula: They should draw only two structures from these aldehydes.    Student gets full marks if they draw two correct displayed structures **Or** any other correct structures. *One mark for each structure.	2
		Type of isomer: Functional group isomer Displayed formula: They should draw two structures from these ketone    Student gets full marks if they draw two correct displayed structures **Or** any other correct structures. *One mark for each structure.	2

Part	Section	The answer	The mark
19	a (i)	ketone	1
	a (ii)	alkene	1
	b	trans	1
	c(i)	It is a **C** atom attached to 4 different groups.	1
	c(ii)		1
	c(iii)	 Note: Student gets a full mark if they draw **one** correct skeletal structure.	1
20	a(i)	3,4-dimethylehexanal	1
	a(ii)	6-chloro-2-hexanol	1
	b		1
	c(i)	A	1
	c(ii)	H	1
	d	C_5H_{10}	1
	e	Both methyl groups are on opposite sides.	1
	f	**J** Because the **SECOND C** atom is attached to 4 different groups (OH, H, CH_2OH, CHO) OR Because the **SECOND C** atom in compound **D** is not attached to 4 different groups (H, H, CH_2OH, CHO)	1 1

<table>
<tr><th>Part</th><th>Section</th><th>The answer</th><th>The mark</th></tr>
<tr><td rowspan="5">21</td><td>a (i)</td><td></td><td>1</td></tr>
<tr><td>a (ii)</td><td></td><td>1</td></tr>
<tr><td>b</td><td>Pt/Ni</td><td>1</td></tr>
<tr><td>c (i)</td><td>Free-radical substitution reaction by Br_2 OR Cl_2</td><td>1</td></tr>
<tr><td>c (ii)</td><td>UV (Ultraviolet light)</td><td>1</td></tr>
<tr><td rowspan="4">22</td><td>a</td><td>Unsaturated</td><td>1</td></tr>
<tr><td>b</td><td>$KMnO_4$ OR [O]</td><td>1</td></tr>
<tr><td>c</td><td>No, No reaction</td><td>1</td></tr>
<tr><td>d</td><td>Bromine water</td><td>1</td></tr>
<tr><td rowspan="4">23</td><td>a.i</td><td></td><td>1</td></tr>
<tr><td>a.ii</td><td>H^+ or H</td><td>1</td></tr>
<tr><td>a.iii</td><td>Cl^-</td><td>1</td></tr>
<tr><td>b</td><td>Based on the Markovnikov's rule, the H atom from HCl is added to the C (of the alkene double bond) that already has more H atoms.</td><td>1</td></tr>
<tr><td rowspan="2">24</td><td>a</td><td><table><tr><th>Steps</th><th>Reactants</th><th>Products</th></tr><tr><td>Initiation</td><td></td><td></td></tr><tr><td></td><td>$C_2H_6 + Cl\cdot$</td><td></td></tr><tr><td>Termination</td><td></td><td></td></tr></table></td><td>1
1
1</td></tr>
<tr><td>b</td><td>$2Cl\cdot \longrightarrow Cl_2$
$C_2H_5\cdot + Cl\cdot \longrightarrow C_2H_5Cl$</td><td>1
1</td></tr>
</table>

This is the end of the Marking Guide





امتحان دبلوم التعليم العام

لكلية الحرس السلطاني العماني التقنية (ثنائية اللغة)

الفصل الدراسي الأول - الدور الثاني - للعام الدراسي ١٤٤٦ /١٤٤٧ هـ - ٢٠٢٤ / ٢٠٢٥ م

تنبيه:
- المادة: الكيمياء.
- الأسئلة في (١٤) صفحة.
- زمن الإجابة: ثلاث ساعات.
- الإجابة في الورقة نفسها.

تعليمات مهمة:

- يجب الحضور إلى قاعة الامتحان قبل عشر دقائق على الأقل من بدء زمن الامتحان.
- يجب إحضار أصل ما يثبت الهوية وإبرازها للعاملين بالامتحانات.
- يجب الالتزام بالزي (الدشداشة البيضاء والمصر أو الكمة للذكور) والزي المدرسي للطالبات ، ويستثنى من ذلك الدارسون من غير العمانيين بشرط الالتزام بالذوق العام، ويمنع على جميع المتقدمات ارتداء النقاب داخل المركز وقاعات الامتحان.
- يحظر على الممتحنين اصطحاب الهواتف النقالة وأجهزة النداء الآلي وآلات التصوير والحواسيب الشخصية والساعات الرقمية الذكية والآلات الحاسبة ذات الصفة التخزينية والمجلات والصحف والكتب الدراسية والدفاتر والمذكرات والحقائب اليدوية والآلات الحادة أو الأسلحة أياً كان نوعها وأي شيء له علاقة بالامتحان.
- يجب على الممتحن الامتثال لإجراءات التفتيش داخل المركز طوال أيام الامتحان.
- 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.

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

1) What is the conjugate acid for the following reaction?

$NH_3(aq) + H_2O(l) \rightleftharpoons NH_4^+(aq) + OH^-(aq)$

○ NH_3 ○ NH_4^+

○ OH^- ○ H_2O

2) What is the hydrogen ion concentration in mol dm^{-3}, $[H^+]$ of a solution that has the pH (1.00)?

○ 0.001 ○ 0.01

○ 0.10 ○ 1.00

3) Which of the following acids is the weakest?

Acid	pK_a
HX	1.82
HM	3.32
HY	4.77
HZ	4.89

○ HX ○ HM

○ HY ○ HZ

4) The pH of a (0.02 mol dm^{-3}) solution of an unknown weak acid is (3.7). What is the pK_a of this acid?

○ 3.2 ○ 3.7

○ 4.9 ○ 5.7

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Question 1 continued

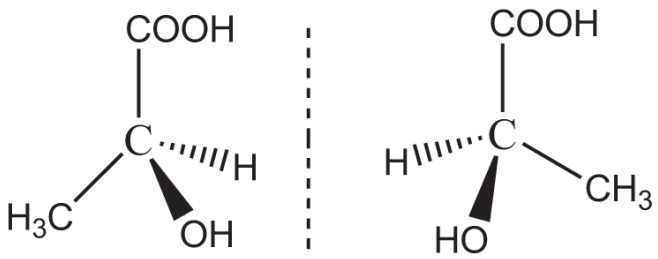
5) Which is the correct expression for the solubility product constant, K_{sp}, for (Ag_2CrO_4)?

- ☐ $K_{sp} = [Ag^+][CrO_4^{2-}]$
- ☐ $K_{sp} = [Ag^+]^2[CrO_4^{2-}]$
- ☐ $K_{sp} = [Ag^+][CrO_4^{2-}]^2$
- ☐ $K_{sp} = [Ag^+]^2[CrO_4^{2-}]^2$

6) What is the correct general formula for aldehydes?

- ☐ $C_nH_{2n}O$
- ☐ $C_nH_{2n+1}OH$
- ☐ $C_nH_{2n+1}COOH$
- ☐ $C_nH_{2n+1}COOC_mH_{2m+1}$

7) What allows the two structures to be enantiomers?



- ☐ The two molecules have different functional groups.
- ☐ The double bond restricts the rotation of carbon atoms.
- ☐ Functional groups are located at different positions on the chain.
- ☐ The two molecules are a mirror image of one another, but are non-superimposable on one another.

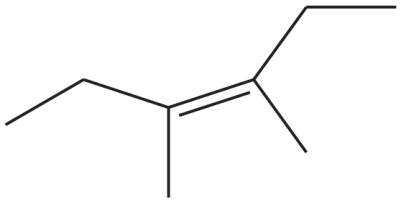
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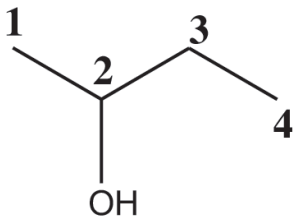
Question 1 continued

8) What is the IUPAC name for this compound?



- ☐ 2,3-diethybut-2-ene
- ☐ 3,4-dimethylhex-3-ene
- ☐ 2-ethyle-3-methylpent-2-ene
- ☐ 4-ethyle-3-methylepent-3-ene

9) The following compound is a stereoisomerism. Which (C) atom is a chairl center?



- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4

10) Which one is a pair of functional group isomers?

☐	CH_3COOCH_3	and	$(CH_3)_2COOH$
☐	$(CH_3)_2CHCH(CH_3)_2$	and	$(CH_3)_3CCH_2CH_3$
☐	$CH_3COOCH_2CH_3$	and	$CH_3CH_2COOCH_3$
☐	$ClCH_2CH_2COCH_3$	and	$CH_3CH_2COCH_2Cl$

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Question 1 continued

11) What is the correct statement for the following reaction mechanism?

$$CH_3CH_2Br + NH_3 \xrightarrow[\text{Heat}]{\text{Pressure}} CH_3CH_2NH_2 + HBr$$

- ☐ NH_3 acts as a nucleophile.
- ☐ NH_3 is a non-polar molecule.
- ☐ This reaction mechanism is known as a nucleophilic addition.
- ☐ This reaction mechanism is known as an electrophilic substitution.

12) Which of the following compounds is a tertiary halogenoalkane?

- ☐ $CHCl_3$
- ☐ $(CH_3)_2CHCl$
- ☐ $(CH_3)_2CHCH_2Cl$
- ☐ $(CH_3)_2CClCH_2CH_3$

13) Which reaction will **not** produce pentene?

- ☐ Cracking of C_8H_{18}
- ☐ Hydrogenation of C_5H_{12}
- ☐ Dehydration of $C_5H_{11}OH$
- ☐ Elimination of hydrogen bromide from $C_5H_{11}Br$

14) The following table shows the length of 4 different carbon-halogen bonds:

Bond symbol	Bond length (A)
R-M	1.39
R-Z	1.78
R-W	1.93
R-Y	2.14

Which compound will be the **last** to produce a precipitate when mixed with aqueous silver nitrate in ethanol?

- ☐ R-M
- ☐ R-Z
- ☐ R-W
- ☐ R-Y

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Question 2: Extended Responses (56 marks)

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) A buffer solution is prepared using (2.35×10^{-2}mol dm^{-3}) of methanoic acid (CH_3COOH) and (1.84×10^{-2}mol dm^{-3}) of methanoate in (1.00 dm^3) of solution.

a. Define the term buffer solution. (1 mark)

b. What are the components of a buffer solution in this reaction? (1 mark)

c. Calculate the pH of this buffer solution, knowing that K_a for methanoic acid is (1.78×10^{-4}mol dm^{-3}) at 25°C. (5 marks)

d. Predict the direction of equilibrium if a small amount of HCl were added to the buffer solution. (1 mark)

Explain. (1 mark)

Do not write in this space

Question 2 continued

16) The auto-ionization constant for water when it forms ions is called K_w.

$$H_2O(l) \rightleftharpoons H^+(aq) + OH^-(aq)$$

a. Write the K_w expression. (1 mark)

b. Calculate the pH of 0.001 mol dm^{-3} of KOH. ($K_w = 1.00 \times 10^{-14}$ mol^2 dm^{-6}). (4 marks)

17) The dissolving equation of copper sulfide in pure water is shown below:

$$CuS(s) \rightleftharpoons Cu^{2+}(aq) + S^{2-}(aq)$$

a. Write the K_{sp} expression for copper sulfide. (1 mark)

b. Calculate the molar solubility of copper sulfide,($K_{sp} = 6.3 \times 10^{-36}$). (3 marks)

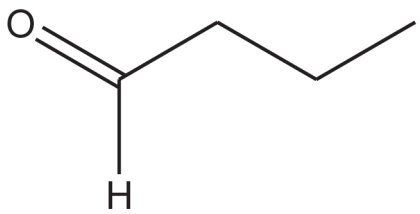
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Question 2 continued

18) Compound (**M**) has several isomers. The structure of (**M**) is:



a. What is the name of the functional group for this compound? (1 mark)

_____

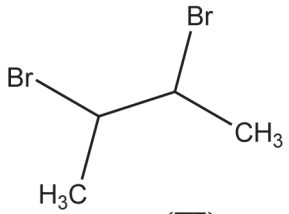
b. Draw the displayed formula of a chain isomer and a functional group isomer of compound (**M**). (**only two structures for each type**) (4 marks)

Type of isomer	Displayed formula	
Chain isomer		
Functional group isomer		

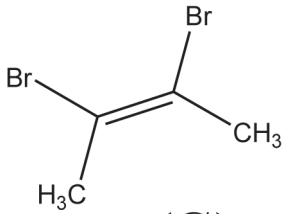
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Question 2 continued

19) The figures below show the structure of dibromo alkane (**F**) and dibromo alkene (**G**):



(F)



(G)

a. Determine the classes of compound for structure:

(i) (**F**): _____ (1 mark)

(ii) (**G**): _____ (1 mark)

b. Which structure has **no** cis\ trans isomerism?

☐ **F** ☐ **G** **(Shade your answer)**

Explain your answer. (2 marks)

_____

_____

c. Optical isomers are another type of stereoisomerism.

(i) What is meant by an optical isomer? (1 mark)

_____

_____

(ii) Why does structure (**G**) **not have** an optical isomer? (1 mark)

_____

_____

d. For compound (**F**):

(i) What is the formula type? (1 mark)

_____

(ii) Deduce the molecular formula. (1 mark)

_____

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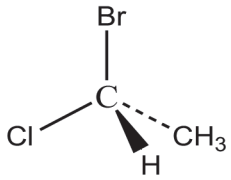
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Question 2 continued

20) The table below shows several compounds.

A



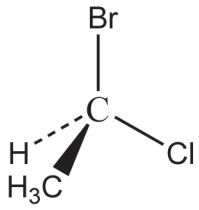
B

$CH_3CH_2CH_2CH_3$

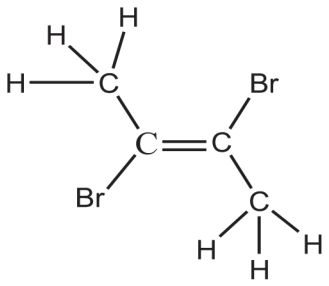
C

$CH_3C(CH_3)_2CH_3$

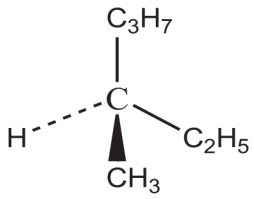
D



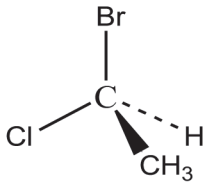
E



F



G



a. Which structure is the chain isomerism of $CH_3CH(CH_3)CH_3$?

☐ **B** ☐ **C** **(Shade your answer)**

Explain your answer. (2 marks)

b. Structure (**E**) has a geometrical isomerism.

(i) Write the IUPAC name for compound (**E**). (1 mark)

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Question 2 continued

(ii) Draw the other isomer of structure (**E**). (1 mark)

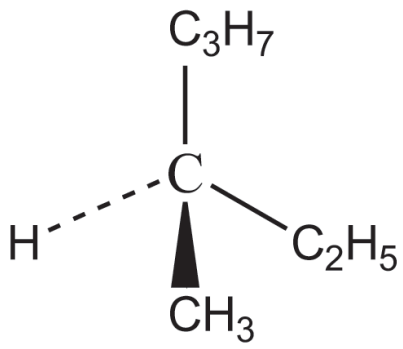
c. Compound (**G**) has an optical isomerism. What is the other optical isomer for this compound? (1 mark)

○ **A** ○ **D** **(Shade your answer)**

d. Compound (**F**) has a chiral center.

(i) What is meant by a chiral center? (1 mark)

(ii) Draw a circle around the chiral center. (1 mark)



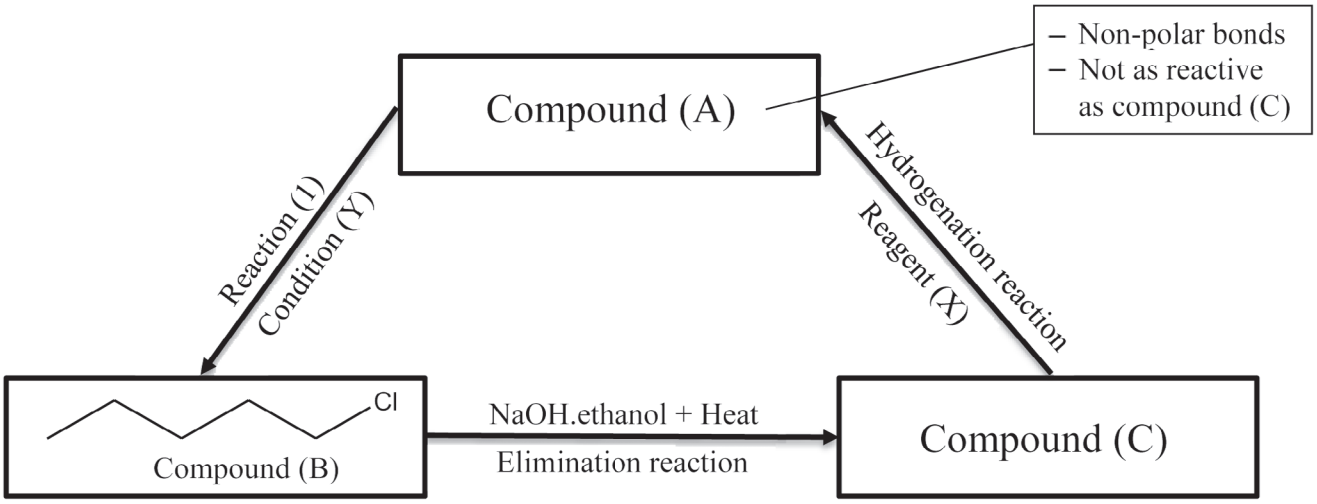
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Question 2 continued

21) Study the following scheme then answer the questions below:



a. Draw the structural formula for:

(i) Compound (**C**): (1 mark)

(ii) Compound (**A**): (1 mark)

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Question 2 continued

b. What is the reagent that is used to convert Compound (**C**) to Compound (**A**)?

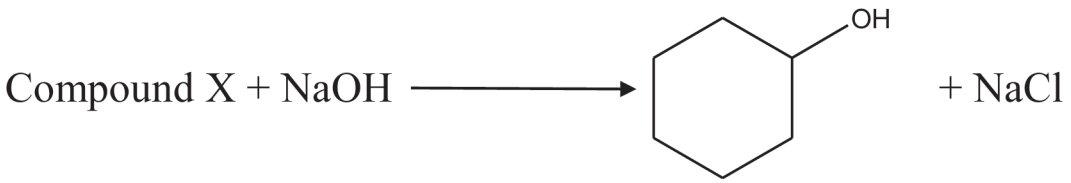
Reagent (**X**): _____ (1 mark)

c. What is the type of reaction and the condition in which Compound (**B**) can be produced from Compound (**A**)?

(i) Reaction (**1**): _____ (1 mark)

(ii) Condition (**Y**): _____ (1 mark)

22) The following equation represents a nucleophilic substitution reaction,



a. What condition does this reaction need to take place? (1 mark)

_____

b. What type of hydrocarbon is compound X? (1 mark)

_____

c. Draw the structural formula of compound X. (1 mark)

d. Explain how this reaction will change if NaOH was replaced with ethanolic NaOH. (1 mark)

_____

_____

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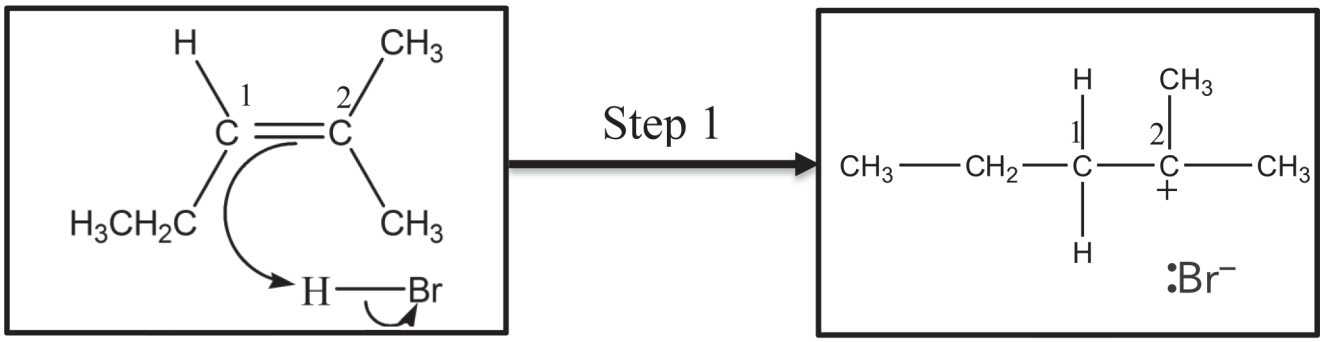
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Question 2 continued

23) The following chemical equation represents an electrophilic addition reaction.

$CH_3CH_2CH = C(CH_3)_2 + HCl \longrightarrow CH_3CH_2CH_2CCl(CH_3)_2$

Part of this reaction mechanism is shown below,



A B

a. Determine the following:

(i) The intermediate: (1 mark)

(ii) The electrophile: _____ (1 mark)

(iii) The nucleophile: _____ (1 mark)

b. The H atom from HBr was added to carbon atom 1. Explain. (1 mark)

_____

_____

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Question 2 continued

24) A free-radical substitution reaction equation is shown below,

$$C_3H_8 + Br_2 \longrightarrow C_3H_7Br + HBr$$

a. What is the condition that must be present for this reaction to begin? (1 mark)

_____

b. Complete the table. (2 marks)

Steps	Reactants	Products
_____	Br_2	$2Br^{\bullet}$
Propagation	_____	$C_3H_7^{\bullet} + HBr$

c. Write two reaction equations which can eliminate free radicals from the system. (2 marks)

_____

_____

_____

[End of the Examination]

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Periodic Table

1 H 1.01																	2 He 4.00
3 Li 6.941	4 Be 9.012											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.31											13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 40.00
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.88	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.38	31 Ga 69.72	32 Ge 72.59	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (98)	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3
55 Cs 132.9	56 Ba 137.3	57 La* 138.9	72 Hf 178.5	73 Ta 180.9	74 W 183.9	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra 226	89 Ac (227)															

Lanthanides	58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (145)	62 Sm 150.4	63 Eu 152.0	64 Gd 157.3	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0
Actinides	90 Th 232.0	91 Pa (231)	92 U 238	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (260)

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مركز القياس والتقويم التربوي
The Center for Educational Assessment and Measurement (CEAM)

سلطنة عمان
وزارة التربية والتعليم

MARKING GUIDE

GENERAL EDUCATION DIPLOMA

ROYAL GUARD OF OMAN TECHNICAL COLLEGE

SEMESTER ONE – SECOND SESSION

CHEMISTRY

2024 / 2025

General Education Diploma, Oman Royal Guard Technical College,
Semester One, Second Session, Chemistry, 2024/2025.

Detailed Exam Specifications for Semester One:

Topics of the units	Weighting %	Multiple choice (20%)					Extended response (80%)					Total marks
		No. of Questions	Marks	Cognitive levels			No. of questions	Marks	Cognitive levels			
				Knowing (30%)	Applying (50%)	Reasoning (20%)			Knowing (30%)	Applying (50%)	Reasoning (20%)	
Quantitative equilibrium	33%	14	5	1	3	1	10	18	6	9	3	23
Introduction to Organic Chemistry	36%		5	2	2	1		20	6	10	4	25
Hydrocarbons and Halogenoalkanes	31%		4	1	2	1		18	5	9	4	22
Total	**100%**		**14**	**4**	**7**	**3**		**56**	**17**	**28**	**11**	**70**

General Education Diploma, Oman Royal Guard Technical College,
Semester One, Second Session, Chemistry, 2024/2025.

Distribution of cognitive domains and marks.

QUESTION ONE: Multiple choice (14 marks)

Item	Mark	Unit	Cognitive domain	Output	Page
1	1	Quantitative equilibrium	Knowing	a	10
2	1	Quantitative equilibrium	Applying	d	13
3	1	Quantitative equilibrium	Reasoning	e	18-19
4	1	Quantitative equilibrium	Applying	c	30
5	1	Quantitative equilibrium	Applying	m	36
6	1	Introduction to Organic Chemistry	Knowing	2.1 a	42-62
7	1	Introduction to Organic Chemistry	Knowing	2.2 d	42-62
8	1	Introduction to Organic Chemistry	Applying	2.1 b	42-62
9	1	Introduction to Organic Chemistry	Applying	2.2 e	42-62
10	1	Introduction to Organic Chemistry	Reasoning	2.2 a	42-62
11	1	Hydrocarbons and Halogenoalkanes	Knowing	3.3 c.iii	87
12	1	Hydrocarbons and Halogenoalkanes	Applying	3.3 b	85
13	1	Hydrocarbons and Halogenoalkanes	Applying	3.2 a	70-72
14	1	Hydrocarbons and Halogenoalkanes	Reasoning	3.3 c.iv	88-90

QUESTION TWO: Extended response (56 marks)

Item	Mark	Unit	Cognitive domain	Output	Page
15 a	1	Quantitative equilibrium	Knowing	f	24
15 b	1	Quantitative equilibrium	Knowing	g	24-25
15 c	5	Quantitative equilibrium	Knowing + 4 applying	d, j	30-32
15 d	2	Quantitative equilibrium	Reasoning	h	24-26
16 a	1	Quantitative equilibrium	Knowing	c	13-14
16 b	4	Quantitative equilibrium	2 Knowing + 2 Applying	c	13-14
17 a	1	Quantitative equilibrium	Applying	m	35-36
17 b	3	Quantitative equilibrium	2 Applying + Reasoning	n	37-39
18 (a)	1	Introduction to Organic Chemistry	Knowing	2.1a	42-62
18 (b)	4	Introduction to Organic Chemistry	Applying	2.1 a 2.2 f	42-62
19 a (i)	1	Introduction to Organic Chemistry	Knowing	2.1 a	42-62
19 a (ii)	1	Introduction to Organic Chemistry	Knowing	2.1 a	42-62
19 (b)	2	Introduction to Organic Chemistry	Applying	2.2 c 2.2b	42-62
19 c (i)	1	Introduction to Organic Chemistry	Knowing	2.2 d	42-62
19 c (ii)	1	Introduction to Organic Chemistry	Applying	2.2 d	42-62
19 d (i)	1	Introduction to Organic Chemistry	Knowing	2.1 c	42-62
19 d (ii)	1	Introduction to Organic Chemistry	Reasoning	2.1 a	42-62
20 (a)	2	Introduction to Organic Chemistry	Applying	2.2 a	42-62
20 b (i)	1	Introduction to Organic Chemistry	Applying	2.1 b	42-62
20 b (ii)	1	Introduction to Organic Chemistry	Reasoning	2.1 a 2.2 a	42-62
20 c	1	Introduction to Organic Chemistry	Reasoning	2.2 d	42-62

20 d (i)	1	Introduction to Organic Chemistry	Knowing	2.2 d	42-62
20 d (ii)	1	Introduction to Organic Chemistry	Reasoning	2.2 d	42-62
21 a (i)	1	Hydrocarbons and Halogenoalkanes	Reasoning	3.2 a.ii	71-72
21 a (ii)	1	Hydrocarbons and Halogenoalkanes	Applying	3.2 a.ii	71-72
21 b	1	Hydrocarbons and Halogenoalkanes	Reasoning	3.2 a.ii	71-72
21c (i)	1	Hydrocarbons and Halogenoalkanes	Reasoning	3.3 c.i	86
21 c (ii)	1	Hydrocarbons and Halogenoalkanes	Knowing	3.2 b.ii	75
22 a	1	Hydrocarbons and Halogenoalkanes	Knowing	3.3 c.i	86
22 b	1	Hydrocarbons and Halogenoalkanes	Knowing	3.3 c.i	86
22 c	1	Hydrocarbons and Halogenoalkanes	Applying	3.3 c.i	86
22 d	1	Hydrocarbons and Halogenoalkanes	Reasoning	3.2 a.i	70
23 a (i)	1	Hydrocarbons and Halogenoalkanes	Applying	3.3 a.ii	83
23 a (ii)	1	Hydrocarbons and Halogenoalkanes	Applying	3.3 a.ii	83
23 a(iii)	1	Hydrocarbons and Halogenoalkanes	Applying	3.3 a.ii	83
23 b	1	Hydrocarbons and Halogenoalkanes	Applying	3.3 a.ii	83
24 a	1	Hydrocarbons and Halogenoalkanes	Knowing	3.1 c	68-69
24 b	2	Hydrocarbons and Halogenoalkanes	Knowing + Applying	3.1 c	68-69
24 c	2	Hydrocarbons and Halogenoalkanes	Applying	3.1 c	68-69

General Education Diploma, Oman Royal Guard Technical College,
Semester One, Second Session, Chemistry, 2024/2025.

TOTAL MARKS: 70 **PAGES: 6**

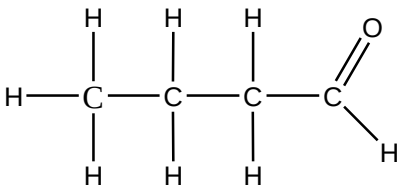
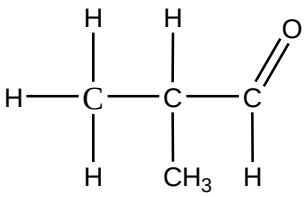
Question One (14 Marks)

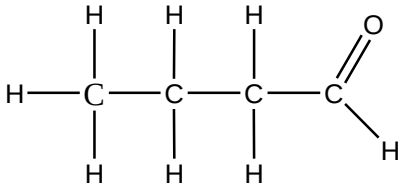
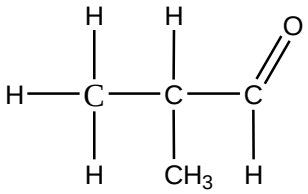
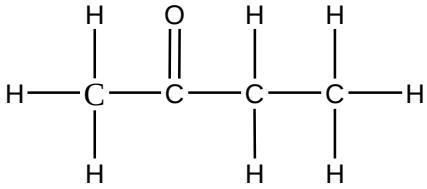
There are 14 multiple-choice items. Each correct answer is worth ONE mark.

Item	Correct option	
1	b	NH_4^+
2	c	0.10
3	d	HZ
4	d	5.7
5	b	$K_{sp} = [Ag^+]^2[CrO_4^{2-}]$
6	a	$C_nH_{2n}O$
7	d	The two molecules are a mirror image of one another, but are non-superimposable on one another
8	b	3,4-dimethylhex-3-ene.
9	b	2
10	a	CH_3COOCH_3 and $(CH_3)_2COOH$
11	a	NH_3 acts as a nucleophile.
12	d	$(CH_3)_2CClCH_2CH_3$
13	b	Hydrogenation of C_5H_{12}.
14	a	R-M

Question Two (56 Marks)

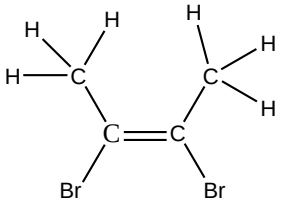
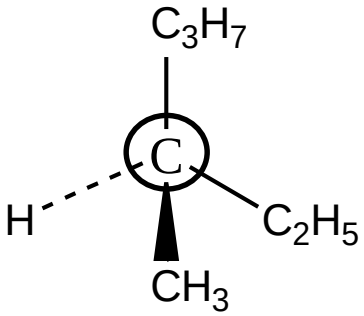
Part	***Section***	***The answer***	***The mark***
15	a	A buffer solution resists changes in pH when small amounts of acid or base are added.	1
	b	CH_3COOH and CH_3COO^- **Or,** weak acid and salt of weak acid. **Or,** weak base and salt of weak base.	1
	c	The buffer is a mixture of: $RCOOH(aq)$ /$CH_3COOH(aq)$ + $CH_3COO^-(aq)$ $RCOOH(aq)$ /$CH_3COOH(aq)$ ⇋ $CH_3COO^-(aq)$ + $H^+(aq)$ Molarity of methanoic acid and methanoate, (M = no of moles /V dm^3) $M[CH_3COOH] = 2.35\times10^{-2}mol/1.00dm^3 = 2.35\times10^{-2}\ mol\ dm^{-3}$ $M[CH_3COO^-] = 1.84\times10^{-2}mol/1.00dm^3 = 1.84\times10^{-2}\ mol\ dm^{-3}$ **$K_a = [CH_3COO^-][H^+]/[CH_3COOH]$** **$[H^+] = K_a \times [CH_3COOH]/[CH_3COO^-]$** **$-\log_{10}[H^+] = -\log_{10}K_a - \log_{10}[CH_3COOH]/[CH_3COO^-]$** **$pH = -\log_{10}(1.78\times10^{-4}mol\ dm^{-3}) -\log_{10}(2.35\times10^{-2}mol\ dm^{-3}/1.84\times10^{-2}mol\ dm^{-3})$** $pH = 3.75 -\log_{10}(1.277)$ **pH= (3.75) – (0.106)** pH = **3.64**	1 1 1 1 1 1
	d	The equilibrium shifts to the **left**. Or, **left.** **To resist changes in the pH**, Or, **increase** the concentration of **acid**. Or, **reduce** the concentration of the **salt**. Or, **return** the **equilibrium** to the system.	1 1

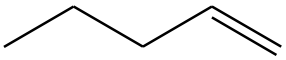
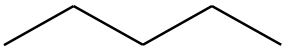
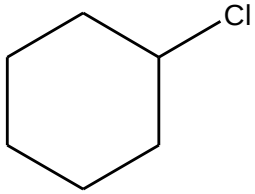
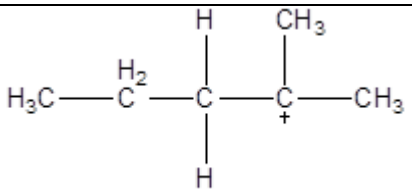
Part	Section	The answer	The mark
16	a	$\mathbf{K_w = [H^+][OH^-]}$	1
	b	$KOH_{(aq)} \rightarrow K^+_{(aq)} + OH^-_{(aq)}$ $K_w = [H^+][OH^-]$ $\mathbf{[H^+] = K_w / [OH^-]}$ $\mathbf{[H^+] = 1.00\times10^{-14}\ mol^2\ dm^{-6} / 0.001\ mol\ dm^{-3}}$ $[H^+] = 1.00\times10^{-11}\ mol\ dm^{-3}$ $\mathbf{pH = -\log_{10}(1.00\times10^{-11})}$ pH= **11**	1 1 1 1
17	a	$\mathbf{K_{sp} = [Cu^{2+}][S^{2-}]}$	1
	b	From the equilibrium equation, $[Cu^{2+}] = [S^{2-}] = x$ $K_{sp} = [Cu^{2+}][S^{2-}]$ $\mathbf{6.3\times10^{-36} = (x)(x)}$ **Or,** $\mathbf{6.3\times10^{-36} = (x)^2}$ $\mathbf{x = \sqrt[2]{6.3\times10^{-36}}}$ $x = \mathbf{2.51\times10^{-18}}$	1 1 1
18	a	aldehyde	1
	b	Type of isomer: Chain isomer Displayed formula: **For aldehyde:**  	4

		Functional group isomer	**Aldehyle:**   **Ketone:** 	

Note: Student gets full marks if they draw the two correct displayed structures **Or** any other correct structures for each type.

One mark for each type of structure.

Part	***Section***	***The answer***	***The mark***
19	a (i)	Alkane	1
	a (ii)	Alkene	1
	b	**F** The C atom on **compound F** has a free rotation around the C-C bond, so the attached groups to the C-C bond have no fixed positions. **Or** Because in structure **G** there is no free rotation around a C=C bond due to the presence of a π bond	2
	c (i)	A molecule that has a chiral center which a C atom attaches to 4 different groups. **Or** Isomers that are non-superimposable mirror images on one another.	1
	c (ii)	Because structure G doesn't have a chiral center **Or** Because structure G doesn't have a C atom attached to 4 different groups.	1
	d (i)	Skeletal formula	1
	d (ii)	$CH_3CHBrCHBrCH_3$	1
20	a	**B** Because they have the same molecular formula, but different structural formula.	2
	b (i)	Trans-2,3-dibromobut-2-ene **OR** 2,3-dibromobut-2-ene	1
	b (ii)		1
	c	D	1
	d (i)	It is a **C** atom that is attached to 4 different groups.	1
	d (ii)		1

Part	Section	The answer	The mark
21	a (i)		1
	a (ii)		1
	b	Pt/Ni	1
	c (i)	Free-radical substitution reaction by Br_2 OR Cl_2	1
	c (ii)	UV (Ultraviolet light)	1
22	a	Heat.	1
	b	Halogenoalkane.	1
	c		1
	d	It will be an elimination reaction of Hydrogen halide that produces alkene rather than alcohol.	1
23	a (i)		1
	a (ii)	H^+	1
	a (iii)	Br^-	1
	b	Based on the Markovnikov's rule, the H atom from HBr is added to the C (of the alkene double bond) that already has more H atoms.	1
24	a	UV light (Ultraviolet light)	1
	b	Initiation $C_3H_8 + Br\cdot$	1 1
	c	$2Br\cdot \longrightarrow Br_2$ $C_3H_7\cdot + Br\cdot \longrightarrow C_3H_7Br$ $C_3H_7\cdot + C_3H_7\cdot \longrightarrow C_6H_{14}$ Note: any two correct equations are accepted. 1 mark for each correct equation.	1 1

This is the end of the Marking Guide