

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 ١٤٤٨/١٤٤٧ هـ - ٢٠٢٥ / ٢٠٢٦ م

تنبيه:
- المادة: الكيمياء.
- الأسئلة في (١٥) 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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Answer the following questions

1) What is the conjugate base for the **forward** equilibrium reaction?

$$H_2SO_4(aq) + HIO_3(aq) \rightleftharpoons HSO_4^-(aq) + H_2IO_3^+(aq)$$

[Shade in the bubble (⬭) next to the correct answer]

- ⬭ HIO_3
- ⬭ HSO_4^-
- ⬭ H_2SO_4
- ⬭ $H_2IO_3^+$

[1]

2) Write the K_a expression for the weak acid (C_6H_5COOH).

_____

_____ [1]

3) Calculate the K_a of propanoic acid (CH_3CH_2COOH) given a solution of (0.100) mol dm^{-3} has a pH of (3.0).

_____

_____

_____

_____ [2]

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4) Calculate the K_a of hydrofluoric acid (HF) that has ($pK_a = 3.17$).

_____

_____

_____ [2]

5) Which of the following options in **Table 5-1** gives a buffer solution?

i	$NH_4Cl + NH_3$
ii	$NaOH + HCl$
iii	$NaHSO_4 + H_2SO_4$
iv	$NaF + HF$

Table 5-1

[Shade in the bubble (⬭) next to the correct answer]

⬭ ii and iv

⬭ i and iii

⬭ i and iv

⬭ ii and iii [1]

6) Write the K_{sp} expression for ($Ca(OH)_2$) as the following balanced chemical equation.

$$Ca(OH)_2(s) \rightleftharpoons Ca^{2+}(aq) + 2OH^-(aq)$$

_____

_____ [1]

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7) **Figure 7-1** below shows the change in pH of two solutions (A and B) after adding an acid.

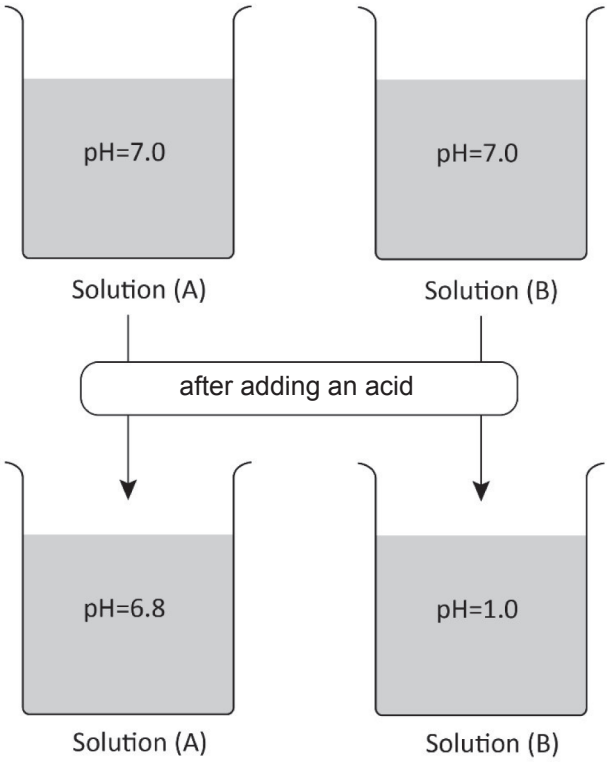


Figure 7-1

a. Which solution acts as a buffer?

_____

- Explain your answer.

_____

_____ [1]

b. Determine the direction of the reaction of an acidic buffer solution after adding a small amount of an acid.

_____

_____ [1]

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8) **Figure 8-1** shows the effect of adding ($Ba(OH)_2$) to a solution of a slightly soluble salt.

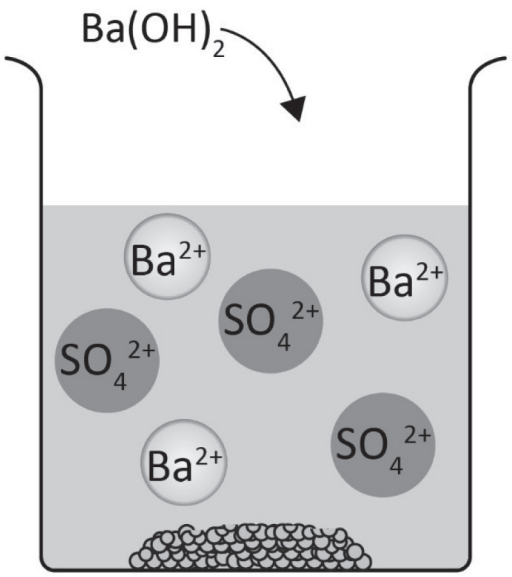


Figure 8-1

a. State **two** changes that occur in the solution.

_____

_____ [2]

b. What is the common ion in the solution?

_____ [1]

9) What is the pH of (0.001 M) solution of HBr?

[Shade in the bubble (🖵) next to the correct answer]

🖵 1.0

🖵 2.0

🖵 3.0

🖵 4.0 [1]

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Do not write in this space

10) The following equation shows an equilibrium reaction.

$$H_3PO_4(aq) + H_2O(aq) \rightleftharpoons H_3O^+(aq) + H_2PO_4^-(aq)$$

a. Define the conjugate base.

_____

_____ [1]

b. Identify the conjugate acid and the conjugate base for the **forward** equilibrium reaction.

Conjugate acid	Conjugate base
_____	_____

[2]

11) What is the correct order of acid's strength according to the pK_a as shown in **Table 11-1**?

Acid (con. 0.1 mol dm^{-3})	HX	HZ	HY
pK_a at 298 K	1.82	6.35	4.20

Table 11-1

[Shade in the bubble (⬭) next to the correct answer]

⬭ HX > HY > HZ

⬭ HY > HZ > HX

⬭ HZ > HY > HX

⬭ HZ > HX > HY [1]

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12) The following equilibrium equations show the solubility product, K_{sp} of two salts.

$$MnS(s) \rightleftharpoons Mn^{2+}(aq) + S^{2-}(aq) \qquad K_{sp}=2.5\times10^{-10}$$

$$CoS(s) \rightleftharpoons Co^{2+}(aq) + S^{2-}(aq) \qquad K_{sp}=3.0\times10^{-26}$$

Determine which salt is more soluble in water. Include in your answer:

- Molar solubility of (MnS).
- Molar solubility of (CoS).

[5]

13) What is the general formula for alkanes?

[Shade in the bubble (⬭) next to the correct answer]

- ⬭ C_nH_{2n}
- ⬭ C_nH_{2n+2}
- ⬭ $C_nH_{2n+1}OH$
- ⬭ $C_nH_{2n+1}COOH$ [1]

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Do not write in this space

14) For the following compound:

$CH_3–CH(OH)–CH_2–CH(CH_3)–CH_3$

Write:

- The IUPAC name.

_____

- The classification of the alcohol compound.

_____ [2]

15) What is the molecular formula for the compound in **Figure 15-1**?

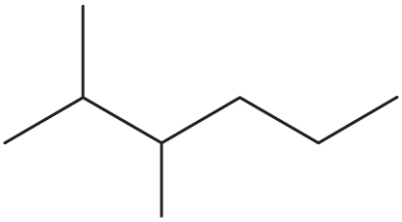


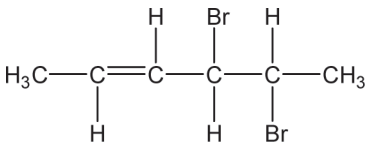
Figure 15-1

[Shade in the bubble (○) next to the correct answer]

- ○ C_8H_{12}
- ○ C_8H_{16}
- ○ C_8H_{17}
- ○ C_8H_{18} [1]

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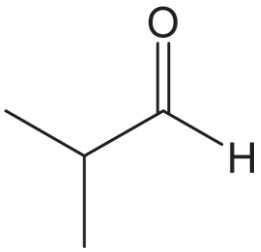
16) Complete the table:

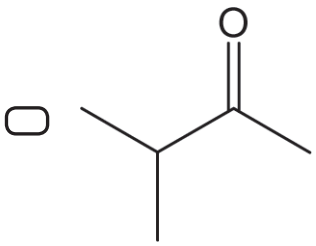
Compound	A	B	C
Displayed Formula			
Name of the compound	Pent-2-ene	_____	2-Bromobutane

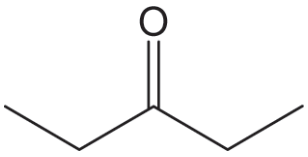
[3]

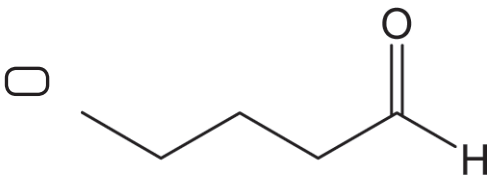
17) What is the correct skeletal formula of Pentanal($C_5H_{10}O$)?

[Shade in the bubble (⬭) next to the correct answer]

⬭ 

⬭ 

⬭ 

⬭ 

[1]

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18) Classify the type of structural isomerism between the following compounds:

(A) CH_3-CH_2-CH_2-CH_2-CHO

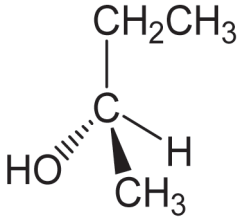
(B) CH_3-CO-CH_2-CH_2-CH_3

(C) CH_3-CH_2-CO-CH_2-CH_3

Compounds **(A)** and **(B)**: _____

Compounds **(B)** and **(C)**: _____ [2]

19) Draw the **optical isomers**(enantiomers) of the following compound:



Mirror

[1]

20) The molecular formula of (C_3H_7Cl) has position isomers.

a. Define the term position isomers.

_____

_____ [1]

b. Draw **two** position isomers for (C_3H_7Cl).

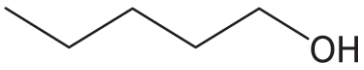
_____

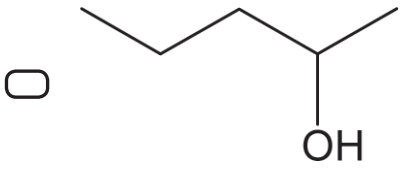
_____ [2]

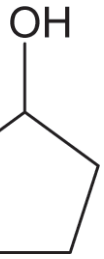
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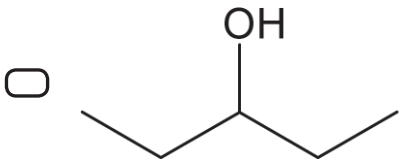
21) Which of the following molecules contains a chiral center?

[Shade in the bubble (⬭) next to the correct answer]

⬭ 

⬭ 

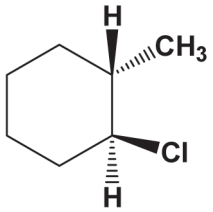
⬭ 

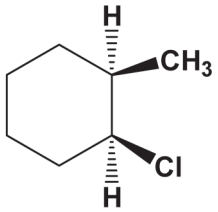
⬭ 

[1]

22) (1-Chloro-2-methylcyclohexane) has a **geometrical** isomerism.

a. Identify the type of geometrical isomerism.





[2]

b. What structural feature allows this compound to form a geometrical isomerism?

_____

_____ [1]

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23) How many chiral centres are in **Figure 23-1**?

[Shade in the bubble (○) next to the correct answer]

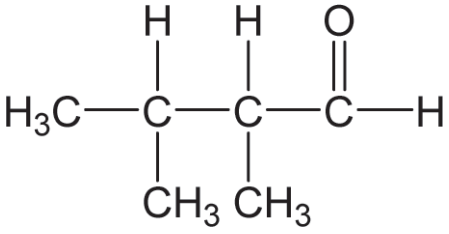
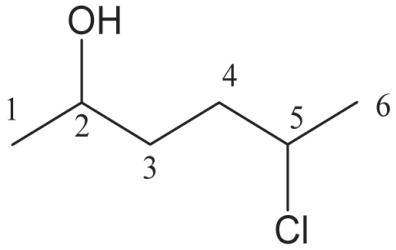


Figure 23-1

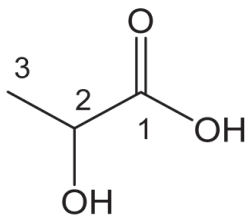
○ 1 ○ 2

○ 3 ○ 4 [1]

24) Study the two compounds shown in **Figure 24-1**.



Compound (A)



Compound (B)

Figure 24-1

Describe how each compound shows an **optical isomerism**. Include in your answer:

- The position of the chiral centers.
- The atoms /groups attached to each chiral center.

_____

_____

_____

_____

_____

_____ [6]

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25) What is the product (X) that is formed when reacting ethene with cold, dilute, acidified $KMnO_4$?

$$C_2H_4 + H_2O + [O] \longrightarrow (X)$$

[Shade in the bubble (⬭) next to the correct answer]

- ⬭ Ether
- ⬭ Ethane
- ⬭ Ethan-2-ol
- ⬭ Ethane-1,2-diol [1]

26) State the **reagent** and **solvent** required to prepare a nitrile from 1-bromobutane.

- The reagent: _____
- The solvent: _____ [2]

27) Two samples of hexane and hexene were prepared.

a. Describe how to distinguish between them using $KMnO_4$.

_____

_____

_____ [2]

b. What type of reaction occurs by adding $KMnO_4$ to the previous compounds?

_____ [1]

28) Which of the following is a **primary** halogenoalkane?

[Shade in the bubble (⬭) next to the correct answer]

- ⬭ $(CH_3)_3C–Cl$
- ⬭ $CH_3–CH_2–Cl$
- ⬭ $CH_3–CHCl–CH_3$
- ⬭ $CH_3–CHCl–CH_2–CH_3$ [1]

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29) Propane burns in a **limited (not enough)** supply of oxygen.

a. What type of combustion occurs?

_____ [1]

b. What products are formed?

_____ [1]

30) Methane is unreactive towards nucleophiles under normal conditions. However, it reacts with chlorine under UV light to form chloromethane as shown below.

$$CH_4 + Cl_2 \xrightarrow{UV} CH_3Cl + HCl$$

a. Explain why methane does not react with nucleophiles in terms of **bond polarity** and **bond strength**.

_____

_____ [2]

b. What is the role of UV light in this substitution reaction?

_____ [1]

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31) 1-Bromopropane is reacted under two different conditions, as in the following:

$$CH_3CH_2CH_2Br + NaOH(aq) \xrightarrow{\text{Heat}} (X)$$

$$CH_3CH_2CH_2Br \xrightarrow{\text{NaOH(ethanol).Heat}} (Y)$$

Which of the following options is correct?

[Shade in the bubble (⬭) next to the correct answer]

	(X)	(Y)
⬭	Propan-1-ol	Prop-1-ene
⬭	Prop-1-ene	Propan-1-ol
⬭	Prop-1-ene	Prop-2-ene
⬭	Propan-1-ol	Propan-2-ol

[1]

32) Write the chemical equation for the combustion of hexane (C_6H_{14}) with **excess (enough)** oxygen.

_____

_____ [2]

33) **Table 33-1** shows two hydrocarbon compounds (A) and (B) which react under the given conditions to form an alkane.

Hydrocarbon compound	(A)	(B)
Catalyst	Ni	Al_2O_3
Temperature (°C)	140	500

Table 33-1

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a. What is the name of the reaction that compound (B) undergoes?

_____ [1]

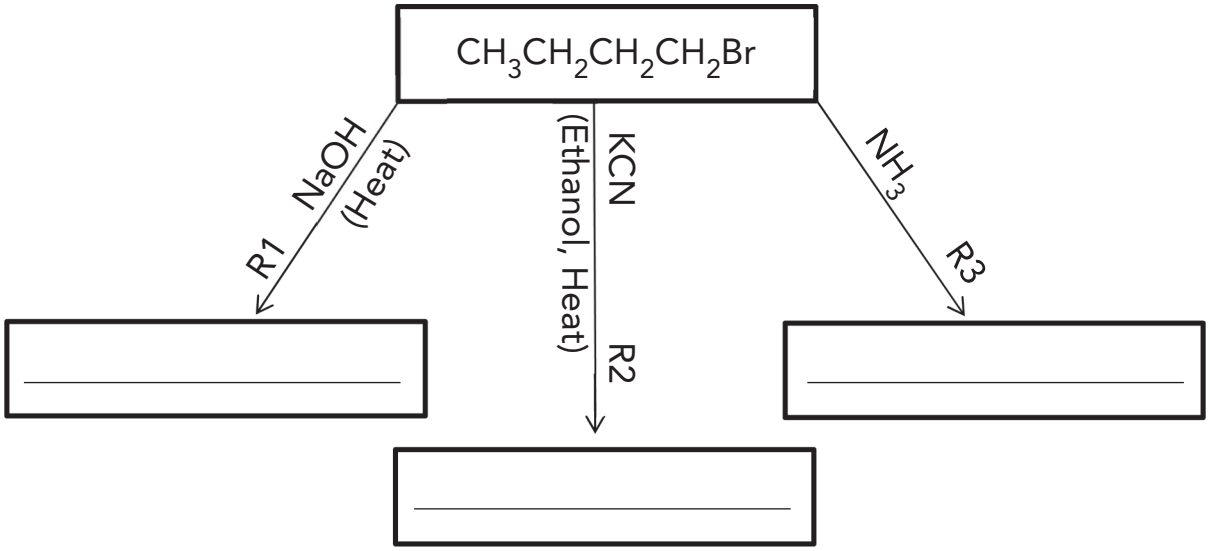
b. Which class of hydrocarbons do compounds (A) and (B) belong to?

Compound (A): _____

Compound (B): _____ [2]

34) Three nucleophilic substitution reactions (R1, R2, R3) were carried out as shown below.

a. Complete the scheme.



[3]

b. State one of the required conditions for reaction R3.

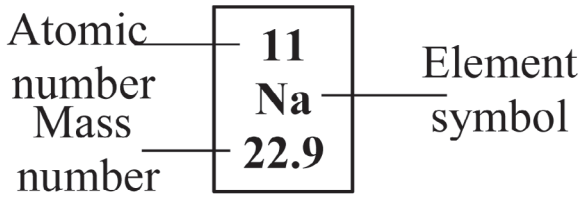
_____ [1]

[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)

وزارة التربية والتعليم

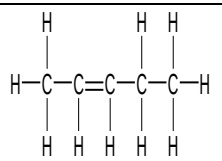
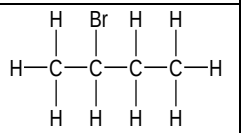
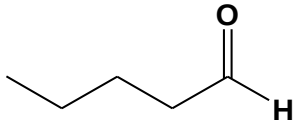
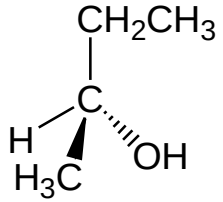
Marking Guide of General Education Diploma Royal Guard of Oman First Semester- First session 2025/2026

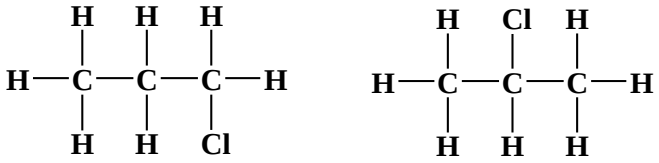
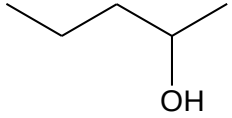
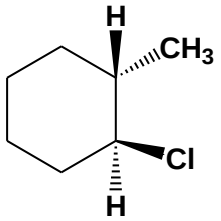
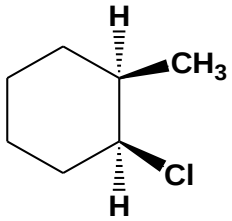
Note: Marking scheme in (8) sheets. Subject: Chemistry Total marks: (70)

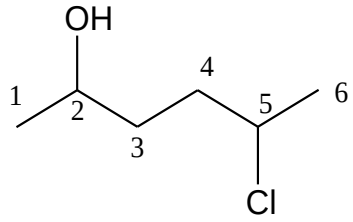
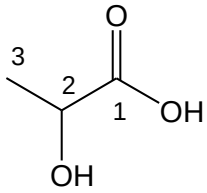
Item	Answer	Mark	Additional Information	Unit	Page	Learning Outcome
1	HSO_4^-	1		Quantitative equilibrium	10	a
2	$K_a = \frac{[H^+][C_6H_5COO^-]}{[C_6H_5COOH]}$	1			19	c
3	$[H^+] = 10^{-pH}] = 10^{-3.0} = \mathbf{0.001\ mol\ dm^{-3}}$ $[HX] = 0.100\ mol\ dm^{-3}$ $K_a = \frac{[H^+]^2}{[HX]} = \frac{(0.001)^2}{(0.100)} = \mathbf{0.001 = 1.0x10^{-5}}$	1 1			18-21	c
4	$\mathbf{pK_a = -log_{10}K_a}$ $K_a = 10^{-pK_a}$ $K_a = 10^{-3.17}$ $K_a = \mathbf{6.76x10^{-4}}$	1 1			19	c

Item		Answer	Mark	Additional Information	Unit	Page	Learning Outcome
5		i and iv	1		Quantitative equilibrium	24-25	g
6		$K_{sp} = [Ca^{2+}][OH^{-}]^2$	1			35-39	m
7	**a**	- Solution (A) - The explanation: The buffer solution **resists/controls changes** in pH. OR There is a small change in the pH.	1	accept any answer that gives the same meaning.		24-25	h
	b	The reaction is shifting to the left, **or** The reaction is shifting to the reactants.	1				
8	**a**	• Shifting the reaction to the left, **or**, • Decreasing the solubility of salt, **or**, • Decreased the amount of dissolved $BaSO_4$ • More $BaSO_4$ is precipitated.	1 1	accept any **two** answers that give the same meaning.		40	o
	b	Ba^{2+}ions or Barium ions.	1				
9		3.0	1			*12*	d
10	**a**	When an acid loses its proton (H^+) it becomes a conjugate base. Or Conjugate base is an acid that **loses** protons, H^+	1			8-10	a,b

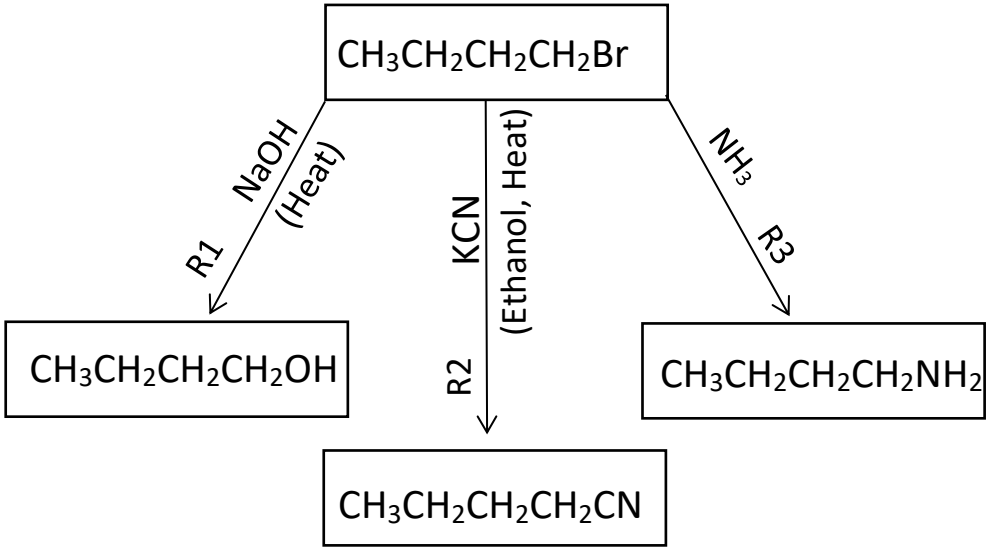
Item		Answer	Mark	Additional Information	Unit	Page	Learning Outcome
10	**b**	Conjugate acid: $H_3O^+(aq)$; Conjugate base: $H_2PO_4^-(aq)$	1 1			8-10	a,b
11		$HX > HY > HZ$	1			18	e
12		**MnS(s) ($K_{sp} = [Mn^{2+}][S^{2-}] = [x][x] = [x]^2$)** MnS(s) ($Ksp = [x]^2 = 2.5x10^{-10}$) MnS(s) ($x = \sqrt{2.5x10^{-10}} = \mathbf{1.6x10^{-5}}$) CoS(s) ($Ksp = [Co^{2+}][S^{2-}] = [x][x] = [x]^2$) CoS(s) ($Ksp = [x]^2 = \mathbf{3.0x10^{-26}}$) CoS(s) ($[x] = \sqrt{3.0x10^{-26}} = \mathbf{1.7x10^{-13}}$) - **MnS(s) is more soluble than CoS(s).** Or, - MnS(s) > CoS(s)	1 1 1 1 1		Quantitative equilibrium	38	n,o
13		$C_n H_{2n+2}$	1			47	2.1a
14		- 4-methylpentan-2-ol - Secondary alcohol	1 1			53-54 48	2.1b 2.1a
15		C_8H_{18}	1			56	2.1c

Item		Answer				Mark	Additional Information	Unit	Page	Learning Outcome
16		Compound	A	B	C	1		Introduction to Organic Chemistry	47-48 53-54	2.1a 2.1b
		Displayed Formula				1 1				
		Name of the compound		4,5-dibromohex-2-ene		1				
17						1			49	2.1a iv
18		Compounds (A) and (B): functional group isomer Compounds (B) and (C): position isomer				1 1			57	2.2a
19						1			61	2.2e

Item		Answer	Mark	Additional Information	Unit	Page	Learning Outcome
20	a	The position isomers: The compounds with the same molecular formula but the functional group is in a different position.	1		Introduction to Organic Chemistry	57	2.2a
	b		1 1	One mark for each isomer.		60	2.2b
21			1			61-63	2.2d
22	a	 Trans-  Cis-	1 1			60	2.2b
	b	In ring (cyclic) structures atoms or group of atoms are unable to rotate around any of the ring carbon -carbon bonds.	1			60	2.2c

Item		Answer	Mark	Additional Information	Unit	Page	Learning Outcome
23		1	1		Introduction to Organic Chemistry	61-62	2.2b
24		 -The compound(A) contains two chiral centers **located at:** Carbon 2 , Carbon 2 is bonded to (–OH, –H, –CH_3, –C_4H_8Cl). Carbon 5 Carbon 5 is bonded to (–Cl, –H, –CH_3, –C_4H_8OH).  The compound (B) contains ONE chiral center. **located at:** Carbon 2 Carbon 2 is bonded to (–OH, –H, –CH_3, –COOH).	1 1 1 1 1 1 1	Student must write the **four** attached atoms/groups to each chiral center in order to get the mark.		61-64	2.2d 2.2e

Item		Answer	Mark	Additional Information	Unit	Page	Learning Outcome
25		Ethane-1,2-diol	1			75	3.2.b.ii
26		The reagent: KCN The solvent: Ethanol	1 1			86	3.3.c
27	**a**	By adding $KMnO_4$ to each, Hexene will react to form a diol. Hexane will not react as it is unreactive towards polar reagents.	1 1		Hydrocarbons and halogen compounds	75	3.2.b.ii
	b	Oxidation	1			85	3.1.d
28		CH_3-CH_2-Cl	1			67	3.3.b
29	**a**	Incomplete combustion.	1			68	3.1.b.i
	b	CO + H_2O	1			69	
30	**a**	The C and H has a similar electronegativity, therefore small polarity, which makes methane unreactive towards polar reagents. The C-H bond is a strong bond, therefore not easy to break.	1 1			75	3.1.c
	b	Breaks the chlorine molecule into free radicals.	1			86	3.1.d
31		(X): Propan-1-ol; (Y): Prop-1-ene	1			75	3.2.a.i 3.3.c.i

Item		Answer	Mark	Additional Information	Unit	Page	Learning Outcome
32		$C_6H_{14} + \frac{19}{2} O_2 \rightarrow 6\boldsymbol{CO_2} + 7\boldsymbol{H_2O}$	1 1	One mark for $\boldsymbol{CO_2}$, and one mark for $\boldsymbol{H_2O}$. Balancing the equation is not required.		67	3.1.b.i
33	**a**	Cracking.	1		Hydrocarbons and halogen compounds	66	3.1.a.i
	b	Compound (A): Alkene. Compound (B): alkane.	1 1				3.1.a.ii
34	**a**		3	One mark for each answer.		86	3.3.c
	b	The required condition: Heat Or pressure.	1				

وزارة التعليم

امتحان دبلوم التعليم العام

لكلية الحرس السلطاني العماني التقنية (ثنائية اللغة)

الفصل الدراسي الأول - الدور الثاني - للعام الدراسي ١٤٤٨/١٤٤٧ هـ - ٢٠٢٥ / ٢٠٢٦ م

تنبيه:
- المادة: الكيمياء.
- الأسئلة في (١١) 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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Answer the following questions

1) What is the **correct** order of increasing acidity for the following acids shown in **Table 1-1**?

acid	pK_a
H_3PO_4	2.16
HCOOH	3.80
CH_3COOH	4.77

Table 1-1

[Shade in the bubble (⬭) next to the correct answer]

- ⬭ $CH_3COOH < HCOOH < H_3PO_4$
- ⬭ $HCOOH < H_3PO_4 < CH_3COOH$
- ⬭ $H_3PO_4 < HCOOH < CH_3COOH$
- ⬭ $H_3PO_4 < CH_3COOH < HCOOH$ [1]

2) Calculate the pH of the solution that has $[H^+]$ of 2.00×10^{-5} mol dm^{-3}.

_____

_____

_____ [1]

3) Identify the conjugate acid and the conjugate base for the **forward** equilibrium reaction,

$$HCl(aq) + H_2O(aq) \rightleftharpoons H_3O^+(aq) + Cl^-(aq)$$

Conjugate acid: _____

Conjugate base: _____ [2]

4) Calculate the pK_a of the benzoic acid ($K_a = 6.30 \times 10^{-5}$ mol dm^{-3}).

_____

_____

_____ [2]

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5) Which pairs will show a common ion effect?

[Shade in the bubble (⬭) next to the correct answer]

⬭ KCl + KOH

⬭ NaCl + HCl

⬭ NaCN + KCN

⬭ $BaSO_4$ + $Ba(OH)_2$ [1]

6) Write the solubility product expression K_{sp} for (MgF_2) as the following balanced chemical equation.

$$MgF_2(s) \rightleftharpoons Mg^{2+}(aq) + 2F^-(aq)$$

_____

_____ [1]

7) State **two** expected changes that may occur upon adding calcium chloride ($CaCl_2$) to a solution of calcium carbonate ($CaCO_3$).

_____

_____

_____ [2]

8) Calculate the pH of a buffer solution containing 0.50 mol dm^{-3} (CH_3COOH) and 0.7 mol dm^{-3} of (CH_3COONa). ($K_a = 1.70 \times 10^{-5}$ mol dm^{-3})

(Show all your work)

_____

_____

_____

_____

_____

_____

_____ [3]

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9) Which of the following statements is **correct** about a buffer solution?

[Shade in the bubble (○) next to the correct answer]

- ○ It maintains a relatively stable pH.
- ○ Its pH does not change upon extreme dilution.
- ○ It consists of a strong acid and its conjugate base.
- ○ Its pH always equals the pK_a of the acid component. [1]

10) Calculate the pH of an aqueous solution that has 0.200 mol dm^{-3} of KOH ($K_w = 1.00 \times 10^{-14}$ mol^2 dm^{-6}).

[3]

11) Which of the following expressions is **correct** for the solubility product constant (K_{sp}) of (Ag_2CrO_4)?

[Shade in the bubble (○) next to the correct answer]

- ○ $[Ag^+]\,[CrO_4^{2-}]$
- ○ $[Ag^+]\,[CrO_4^{2-}]^2$
- ○ $[Ag^+]^2\,[CrO_4^{2-}]$
- ○ $[Ag^+]^2\,[CrO_4^{2-}]^2$ [1]

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12) An acidic solution (HX) was prepared with a concentration of 0.004 mol dm^{-3} that has a pH of (3.12).

$$HX(aq) \rightleftharpoons X^-(aq) + H^+(aq)$$

Calculate the acid dissociation constant, K_a of the acid (HX). Include in your answer:

- The concentration of hydrogen ion $[H^+]$.
- The expression for the acid dissociation constant, K_a.

[5]

13) What is the general formula of alkenes?

[Shade in the bubble (○) next to the correct answer]

- ○ C_nH_{2n}
- ○ C_nH_{2n-2}
- ○ C_nH_{2n+2}
- ○ $C_nH_{2n}OH$

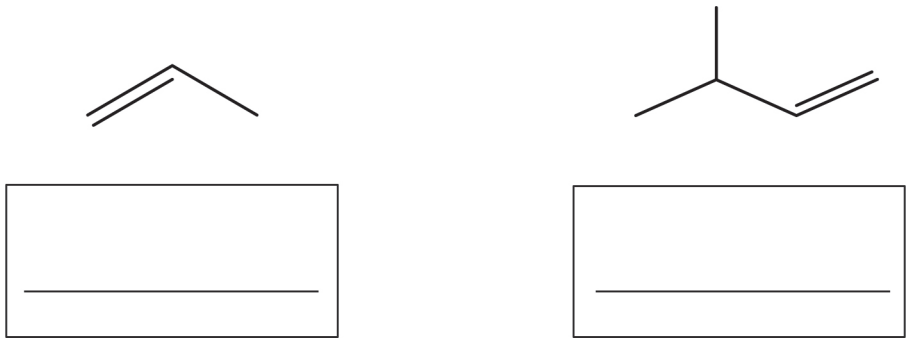
[1]

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14) Write the molecular formula of each compound shown below:



[2]

15) What is the IUPAC name of the compound in **Figure 15-1**?

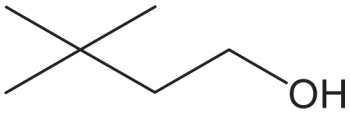


Figure 15-1

[Shade in the bubble (⬭) next to the correct answer]

- ⬭ 3,3-methylbutan-1-ol
- ⬭ 2,2-dimethylbutan-4-ol
- ⬭ 3,3-dimethylbutan-1-ol
- ⬭ 3,3,3-trimethylpropan-1-ol [1]

16) Complete the table below:

Name of compound	Structural formula	Displayed formula	Name of the functional group
2-Bromopropane	_____	_____	_____

[3]

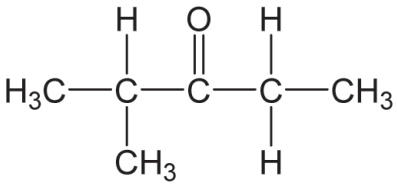
17) Which of the following molecules contains a **chiral centre**?

[Shade in the bubble (⬭) next to the correct answer]

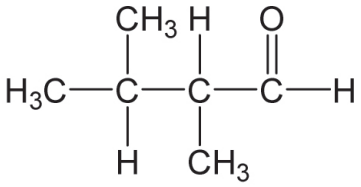
- ⬭ $CH_3–CH_2–CH_3$
- ⬭ $CH_3–CH_2–OH$
- ⬭ $CH_3–CH(OH)–CH_3$
- ⬭ $CH_3–CH(F)–CH_2–CH_3$ [1]

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18) For the followings compounds in **Figure 18-1**



Compound (X)



Compound (Y)

Figure 18-1

a. Explain why compound (X) and compound (Y) are structural isomers.

_____

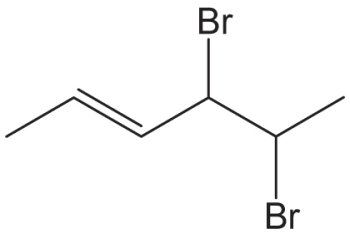
_____ [1]

b. Which homologous family does compound (Y) belong to?

_____

_____ [1]

19) Name the following compound.



_____ [1]

20) Draw the **three** chain isomers with the molecular formula of C_5H_{12}.

_____

_____

_____

_____

_____ [3]

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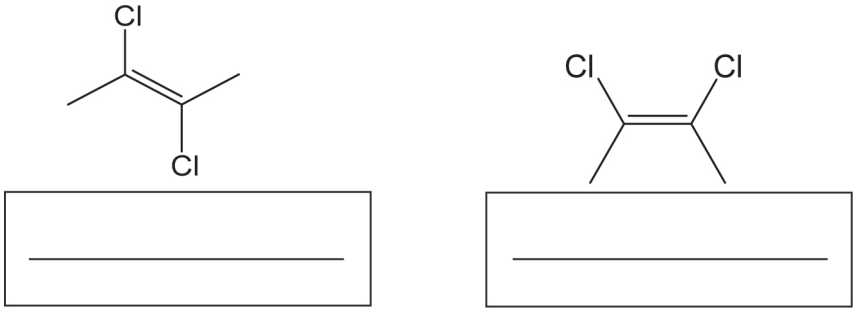
21) Which statement is **correct** about 2-methylpropan-1-ol?

[Shade in the bubble (○) next to the correct answer]

- ○ It is a secondary alcohol.
- ○ It contains a chiral center.
- ○ It is a chain isomer for a butanol.
- ○ Its molecular formula is $C_4H_{12}O$. [1]

22) The following compound has a **geometrical** isomerism.

a. Identify the type of geometrical isomerism.



[2]

b. Explain why the previous compound is considered as a geometrical isomerism?

_____

_____ [1]

23) Which type of isomerism do the following two molecules show in **Figure 23-1**?

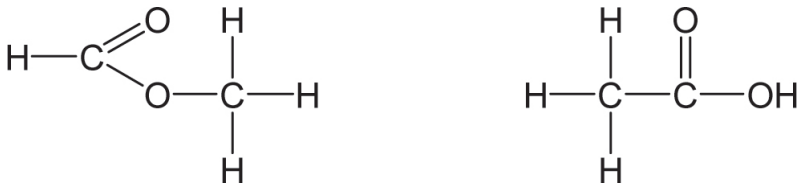


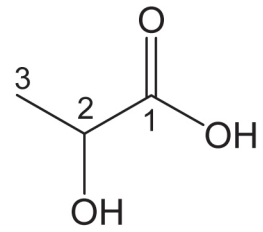
Figure 23-1

[Shade in the bubble (○) next to the correct answer]

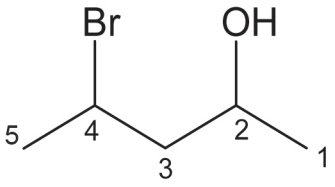
- ○ Chain
- ○ Positional
- ○ Geometrical
- ○ Functional group [1]

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24) Study the compounds shown in **Figure 24-1**



Compound (A)



Compound (B)

Figure 24-1

Compare between these two compounds. Include in your answer:

- The position of the chiral centres.
- The atoms/groups attached to each chiral centre.

[6]

25) Which of the following sets of conditions is most suitable for dehydrating an alcohol to form an alkene?

[Shade in the bubble (⬭) next to the correct answer]

⬭ Ethanolic NaOH, reflux

⬭ Concentrated H_2SO_4,180 °C

⬭ NaOH(aq), room temperature

⬭ Dilute HCl, room temperature [1]

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26) Indicate how oxygen availability determines whether an alkane undergoes complete or incomplete combustion.

- Complete combustion: _____

- Incomplete combustion: _____ [2]

27) Four samples of halogenoalkanes in **Table 27-1** were prepared, then reacted with aqueous silver nitrate.

Halogenoalkane	**A**	**B**	**C**	**D**
R-X bond energy kJ.mol^{-1}	228	346	290	467

Table 27-1

a. Which of the previous halogenoalkanes (**A**, **B**, **C**, **D**) is the fastest to form a precipitate and which is the slowest?

- The fastest: _____

- The slowest: _____ [2]

b. What solvent is used to react the samples with aqueous silver nitrate?

_____ [1]

28) Which of the following is a secondary halogenoalkane?

[Shade in the bubble (⬭) next to the correct answer]

⬭ $(CH_3)_3C–Cl$

⬭ $CH_3–CH_2–CH_2–Cl$

⬭ $(CH_3)_2CCl–CH_2–CH_3$

⬭ $CH_3–CHCl–CH_2–CH_3$ [1]

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29) The cracking reaction of octane produces compound (C_3H_8) and compound (X) as indicated below.

$$C_8H_{18} \xrightarrow{Al_2O_3} C_3H_8 + (X)$$

a. What class of hydrocarbons is compound (X)?

_____ [1]

b. Which compound in the products will not react with $KMnO_4$?

_____ [1]

30) The following equation shows a free radical substitution reaction.

$$CH_4 + Cl_2 \xrightarrow{UV} CH_3Cl + HCl$$

a. State the role of UV light in initiating the reaction above.

_____ [1]

b. Write two equations from the **termination** step of this reaction.

_____

_____

_____ [2]

31) Which statement is **correct** for the following equation?

$$C_2H_4 + Br_2 \longrightarrow C_2H_4Br_2$$

[Shade in the bubble (○) next to the correct answer]

- ○ Br^- acts as a nucleophile.
- ○ Br_2 is attracted to the double bond.
- ○ This mechanism is called nucleophilic addition.
- ○ The double bond in ethene has electron deficiency. [1]

32) Write the chemical equation for the combustion of pentane (C_5H_{12}) when oxygen is **limited (not enough)**.

_____

_____ [2]

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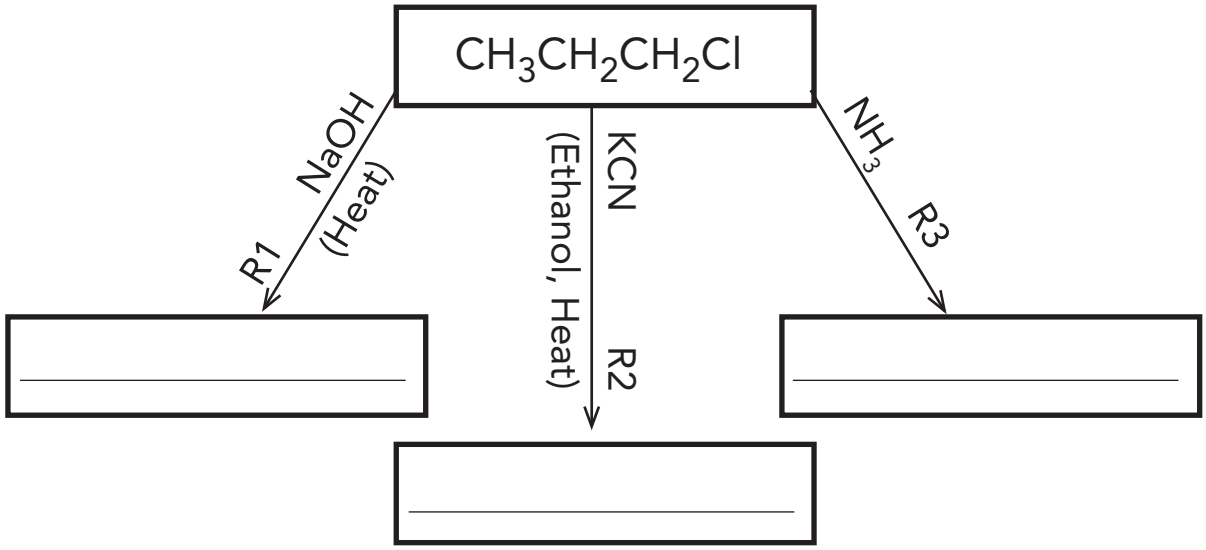
33) Classify each of the following halogenoalkanes into primary, secondary, or tertiary.

Compound	Classification
2-chlorobutane	_____
1-chloro-2-methylpentane	_____
2-bromo-2-methylpropane	_____

[3]

34) Three nucleophilic substitution reactions (R1, R2, R3) were carried out as shown below.

a. Complete the **scheme**.



[3]

b. State one of the required conditions for reaction R3.

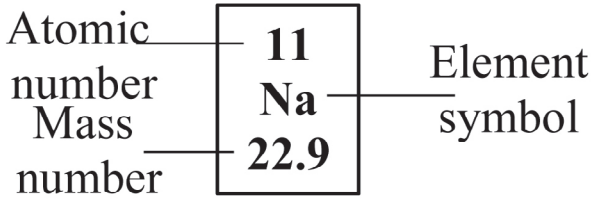
_____ [1]

[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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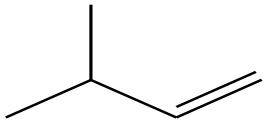
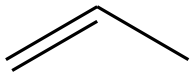
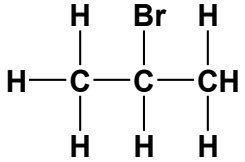
Marking Guide of
General Education Diploma
Royal Guard of Oman
First Semester- Second session
2025/2026

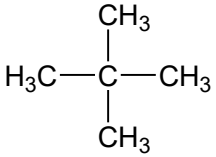
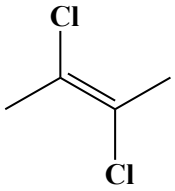
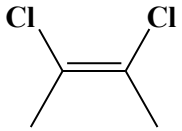
Note: Marking scheme in (10) sheets. Subject: Chemistry Total marks: 70

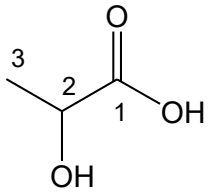
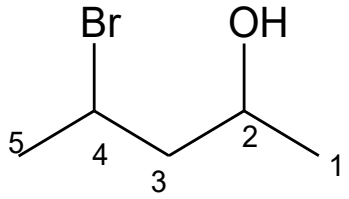
Item	Answer	Mark	Additional Information	Unit	Page	Learning Outcome
1	$CH_3COOH < HCOOH < H_3PO_4$	1		Quantitative equilibrium	18	e
2	$pH = -log_{10}[H^+]$ $pH = -log_{10}(2.00x10^{-5})$ $pH = 4.698 = \mathbf{4.70}$	 1			10-11	d
3	conjugate acid: $H_3O^+(aq)$ conjugate base: $Cl^-(aq)$	1 1			8-10	b
4	$pK_a = -log_{10}K_a = -log_{10}(6.3x10^{-5})$ $\boldsymbol{pK_a = -log_{10}(6.30x10^{-5})}$ $pK_a = \mathbf{4.20}$	 1 1			18-19	c
5	NaCN + KCN				40	o
6	$K_{sp} = [Mg^{2+}][F^-]^2$	1			37	m

Item	Answer	Mark	Additional Information		Page	Learning Outcome
7	- Increasing Ca^{2+} ions in solution, - Shifting the reaction to the left, - Decreasing the solubility of salt, - Increasing salt formation/ More salt is precipitated - Decreasing the amount of dissolved $CaCO_3$	1 1	accept any two of these options or what gives the same meaning.	Quantitative equilibrium	40	o
8	$\mathbf{K_a} = \frac{[\mathbf{H^+}][\mathbf{CH_3COO^-}]}{[\mathbf{CH_3COO^-}]}$ $[H^+] = \frac{Ka\,[CH_3COOH]}{[CH_3COOH]}$ $[H^+] = \mathbf{(1.7x10^{-5})(0.50)/0.70} = 1.21x10^{-5}$ mol dm $^{-3}$ $pH = -\log_{10}[H^+] = -\log_{10}(1.21x10^{-5}) = \mathbf{4.92}$ **Another answer:** $\boldsymbol{pKa = -log_{10}K_a} = -log_{10}(1.70x10^{-5})$ pKa=4.7696 $\boldsymbol{pH = pK_a + \log\frac{[base]}{[acid]}}$ $pH = 4.7696 + \log\frac{0.7}{0.5} = \mathbf{4.92}$	1 1 1			31	g
9	It maintains a relatively stable pH	1			24	h

Item	Answer	Mark	Additional Information		Page	Learning Outcome
10	$\boldsymbol{K_w = [H^+][OH^-]}$ $Or \quad [H^+] = \frac{K_w}{[OH^-]}$ $[H^+] = \frac{1.0x10^{-14}}{0.200}$ $[H^+] = \mathbf{5.00x10^{-14}}$ $pH = -\log_{10}[H^+] = -\log_{10}(5.00x10^{-14}) = \mathbf{13.30}$	1 1 1		Quantitative equilibrium	15	d
11	$K_{sp} = [Ag^+]^2[CrO_4^{2-}]$	1			36-37	m
12	At equilibrium, it is assumed that the concentration of $[H^+] = [X^-] =$ 0.004 mol dm^{-3} pH= -log$_{10}$[H$^+$] **[H$^+$] = 10^{-pH}** [H$^+$] = 10$^{-3.12}$ = **7.585 x 10^{-4}** **K$_a$ = [H^+][X^-]/[HX]** **K$_a$ = (7.585x10^{-4})^2/ 0.004** K$_a$ = 5.753×10^{-7} mol^{2}dm^{-6}/0.004mol dm^{-3} K$_a$= **1.44×10^{-4} mol dm^{-3}**	 1 1 1 1 1			12	c
13	C_nH_{2n}	1			48	2.1a

Item		Answer	Mark	Additional Information	Unit	Page	Learning Outcome
14		 C_5H_{10}  C_3H_6	1 1		Introduction to Organic Chemistry	56	2.1c
15		3,3-dimethylbutan-1-ol	1			46-56	2.1b
16		Name of compound: 2-Bromopropane; Structural formula: $CH_3CH(Br)CH_3$; Displayed formula:  ; Name of the functional group: Halogenoalkane OR haloalkane	1 1 1			46-50	2.1a 2.1c
17		$CH_3–CH(F)–CH_2–CH_3$	1			61-62	2.2e
18	**a**	because they have the same molecular formula (C_4H_8O) but different functional groups. (Y) is an aldehyde while (X) is a ketone	1			57	2.2a
	b	(Y): an aldehyde	1			49,57	2.1a

Item		Answer	Mark	Additional Information	Unit	Page	Learning Outcome
19		4,5-dibromo-2-hexen	1		Introduction to Organic Chemistry	53-55	2.1b
20		$CH_3–CH_2–CH_2–CH_2–CH_3$ $CH_3–CH(CH_3)–CH_2–CH_3$ 	1 1 1			56-58	2.2a
21		it is a chain isomer for a butanol	1			57	2.2a
22	**a**	  trans cis	1 1			59-60	2.2c
	b	Because of the presence of a carbon–carbon double bond(C=C)	1			59	2.2c

Item	Answer	Mark	Additional Information	Unit	Page	Learning Outcome
23	Functional group	1		Introduction to Organic Chemistry	57	2.2a
24	 The compound (A) **located at:** Carbon 2 Carbon 2 is bonded to (–OH, –H, –CH_3, –COOH)  The compound(B) **located at:** Carbon 2, Carbon 2 is bonded to (–OH, –H, –CH_3, – C_3H_6 Br). Carbon 4 Carbon 4 is bonded to (–Br, –H, –CH_3, –C_3H_6 OH).	1 1 1 1 1 1 1	Student must write the **four** attached atoms/groups to each chiral center in order to get the mark.		61-63	2.2d 2.2e

Item		Answer	Mark	Additional Information	Unit	Page	Learning Outcome
25		Concentrated H_2SO_4,180 °C	1		Hydrocarbons and Halogen compounds	70-71	3.2.a.ii
26		Complete combustion: enough oxygen OR Sufficient amount of oxygen OR excess oxygen. Incomplete combustion: not enough oxygen, insufficient amount of oxygen, limited/ low oxygen supply.	1 1	One mark for each.		67	3.1.b.i
27	**a**	The fastest: A The slowest: D	1 1			88-90	3.3.c.iv
	b	Ethanol Or ethanolic.	1			88-90	3.3.c.iv
28		CH_3-CHCl-CH_2-CH_3	1			85	3.3.b
29	**a**	Alkene	1			66	3.1.a.ii
	b	C_3H_8	1			66	3.1.a.ii

Item		Answer	Mark	Additional Information	Unit	Page	Learning Outcome
30	**a**	Breaks the chlorine molecule into free radicals.	1		Hydrocarbons and Halogen compounds	68	3.1.c
	b	$CH_3\bullet + CH_3\bullet \rightarrow C_2H_6$ $CH_3\bullet + Cl\bullet \rightarrow CH_3Cl$ $Cl\bullet + Cl\bullet \rightarrow Cl_2$	1 1	- Each correct equation gets 1 mark. - Any two correct equations are accepted.		68	3.1.c
31		Br^- acts as a nucleophile.	1			78	3.2.c
32		$C_5H_{12} + \frac{11}{2}O_2 \rightarrow 5CO + 6H_2O$	1 1	-1 mark for CO and 1 mark for H_2O. - Balancing the equation is not required.		67	3.1.b.i

<table>
<tr><th>Item</th><th colspan="2">Answer</th><th>Mark</th><th>Additional Information</th><th>Unit</th><th>Page</th><th>Learning Outcome</th></tr>
<tr><td>33</td><td colspan="2"><table>
<tr><th>compound</th><th>classification</th></tr>
<tr><td>2-chlorobutane</td><td>Secondary</td></tr>
<tr><td>1-chloro-2-methylpentane</td><td>Primary</td></tr>
<tr><td>2-bromo-2-methylpropane</td><td>Tertiary</td></tr>
</table></td><td>1

1

1</td><td></td><td rowspan="3">Hydrocarbons and Halogen compounds</td><td>85</td><td>3.3.b</td></tr>
<tr><td rowspan="2">34</td><td>a</td><td>R1: $CH_3CH_2CH_2OH$
R2: $CH_3CH_2CH_2CN$
R3: $CH_3CH_2CH_2NH_2$</td><td>1
1
1</td><td></td><td>86-87</td><td>3.3.c</td></tr>
<tr><td>b</td><td>One of the required conditions: Heat Or pressure.</td><td>1</td><td></td><td>86-87</td><td>3.3.c</td></tr>
</table>