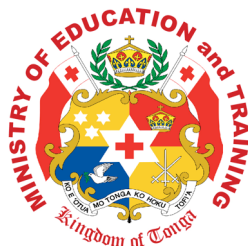


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STUDENT ENROLMENT NUMBER (SEN)									

TONGA FORM SIX CERTIFICATE

2021

CHEMISTRY

QUESTION AND ANSWER BOOKLET

Time allowed: 3 Hours

INSTRUCTIONS:

- Write your **Student Enrolment Number (SEN)** on the top right-hand corner of this page.
- This paper consists of **SEVEN QUESTIONS** and is out of 70 Weighted scores.

QUESTION	STRANDS	TOTAL SKILL LEVEL
ONE	Atomic structure, Bonding and Related Properties	30
TWO	Solid and Related Properties	5
THREE	Kinetic Chemistry	6
FOUR	Organic Chemistry	15
FIVE	Inorganic Chemistry	4
SIX	REDOX Chemistry	8
SEVEN	Quantitative Chemistry	2
TOTAL		70

- Answer ALL QUESTIONS. Write your answers in the spaces provided in this booklet.
- Use a **BLUE** or **BLACK** ball point pen only for writing. Use a pencil for drawing if required.
- If you need more space for answers, ask the supervisor for extra paper. Write your **Student Enrolment Number (SEN)** on each additional sheet, number the questions clearly and insert them in the appropriate places in this booklet.

NOTE: There is a group of the **Periodic Table of the Elements** provided on page 19. The table gives the **Symbol**, **Atomic Number** and the **Relative Atomic Mass** of the elements. The Groups (columns) are numbered I, II, III, IV etc.

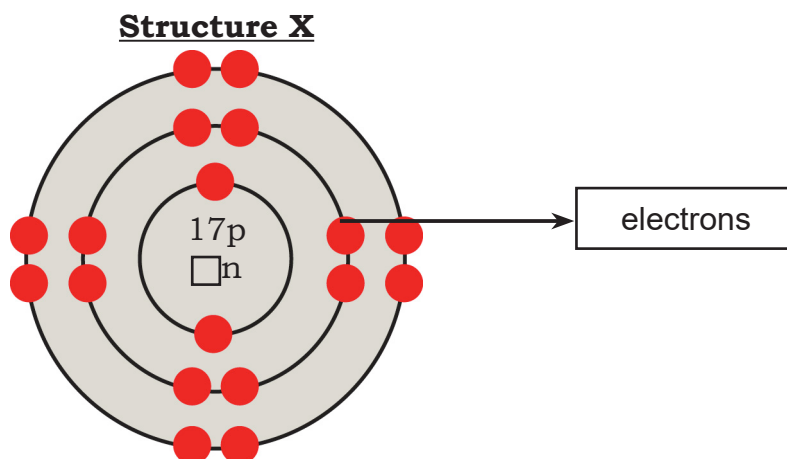
NOTE: The symbol M is used for molar mass. $M(\text{Na}) = \text{g mol}^{-1}$ and $M(\text{CO}_2) = 44 \text{ g mol}^{-1}$.

- Check that this booklet contains pages **2 - 19** in the correct order and that pages 17 - 18 have been deliberately left blank.

YOU MUST HAND IN THIS BOOKLET TO THE SUPERVISOR BEFORE YOU LEAVE THE EXAMINATION ROOM.

QUESTION ONE: ATOMIC STRUCTURE, BONDING and RELATED PROPERTIES

1. Structure X is a monoatomic ion. It consists of 17 protons and 18 electrons. The mass number is 35.



- a. Define the term **monoatomic ion**.

Skill level 1	
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- b. Calculate the number of neutrons.

Skill level 1	
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- c. Name the monoatomic ion represented by **Structure X**.

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- d. How many valence electrons does atom X have?

Skill level 1	
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- e. Electrons are filled and arranged according to orbitals.

Define the **p electron** orbital in the third shell.

Skill level 1	
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2. Sodium bicarbonate is also called baking soda and has many useful purposes. It can form a polyatomic ion, used in baking and for cleaning purposes.



SOURCE: <https://www.google.com/search?q=BAKING+SODA&source>

- a. Define the term **polyatomic ion**.

Skill level 1	
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- b. Write the symbol of the polyatomic ion provided in the instruction above.

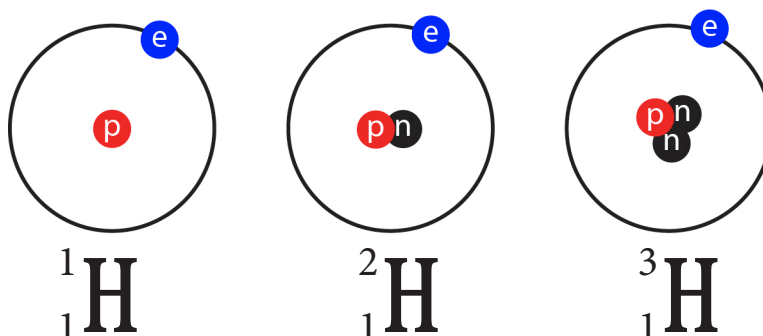
Skill level 1	
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- c. Name the polyatomic ion present in baking soda.

Skill level 1	
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3. **Figure 1** show three different stable isotopes for the element Hydrogen.

Figure 1:



- a. Define the term **isotope**.

Skill level 1	
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- c. State the type of isotope present in 3- Hydrogen, ${}^3_1\text{H}$.

Skill level 1	
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- State which group number in the periodic table is known for making salts or called salt formers.

- In the box below, fill the appropriate unshaded boxes with your corresponding answer for questions **5.a.** and **5.b.** below.

- | Skill level 1 | |
|---------------|--|
| 1 | |
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Skill level 1	
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- Explain the variation of the bonding angle in NF_3 and NH_3 .

Skill level 3	
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6. A molecular compound consists of two different elements, **X** and **Z**, and contains three atoms. Its formula is ZX_2 . The elements have different electronegativities. Depending on the identity of the elements, the molecule could either be polar or non-polar.

a. Define the term **electronegativity**.

Skill level 1	
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b. Should ZX_2 be considered a **polar molecule** or a **non-polar molecule**?

Justify the polarity of ZX_2 [*you do not need to identify the elements of Z and X*].

Skill level 3	
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7. When Potassium Chlorate ($KClO_3$) is heated, it decomposes to potassium chloride and oxygen gas.

a. Write the **balanced equation** for the above chemical reaction.

Skill level 2	
2	
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- b. Calculate the amount of oxygen produced when 8 moles of potassium chlorate is heated.

--

Skill level 2	
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8. Describe how the Lewis structure for COCl_2 is drawn using a dot and cross diagram.

Skill level 2	
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9. The table below shows atoms with their respective electronegativity values.

Atom	Electronegativity value
Hydrogen	2.20
Oxygen	3.44
Chlorine	3.16

Predict with reasons the type of bond that will exist between Hydrogen atom and Chlorine atom compared to the type of bond type formed between hydrogen and oxygen atoms.

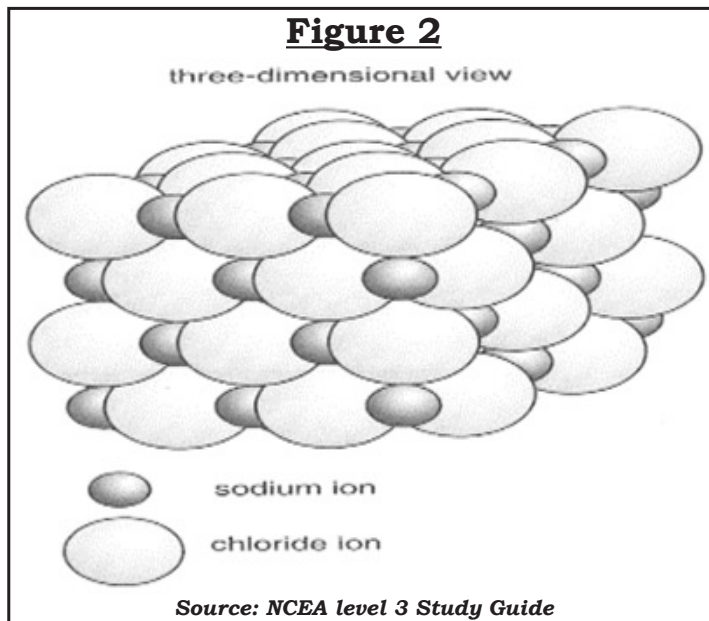
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Skill level 3	
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QUESTION TWO:

SOLID and RELATED PROPERTIES

Study **Figure 2** carefully to answer the question that follows:



1. Determine the bond that are disrupted when the structure above boils.

Skill level 1	
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2. Ethanol is soluble in water whereas Pentanol is insoluble in water.

Discuss the **dissolution** of the two molecular substances mentioned above in water.

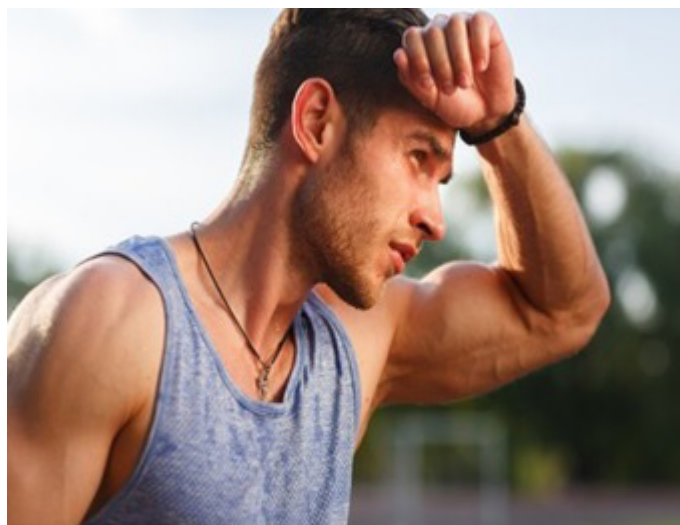
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Skill level 4	
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QUESTION THREE:

KINETIC CHEMISTRY

1. When a person sweats, water is lost from the body by evaporation and exercise speeds it up. Through sweats, sodium chloride (NaCl) in sweat is also excreted.



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source: <https://www.google.com/search>

Differentiate the strengths of chemical bonds that are disrupted when a person sweats.

[illegible]

Skill level 3	
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Skill level 3	
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QUESTION FOUR:**ORGANIC CHEMISTRY**

1. Compound **X** and **Y** are isomers with a molecular formula $C_3H_6O_3$. A 5mL of each compound was taken and placed into two different test tubes and labeled. A solution containing diamminesilver (I) complex ion, $[Ag(NH_3)_2]^+$ was added to each test tubes. Compound X reacted but not compound Y.

Account for the observations made in Compound **X** and Compound **Y**.

Skill level 3	
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2. There are two types of glucose structure, linear and branched.

Explain the differences in the physical properties of the two glucose structures.

Skill level 3

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2

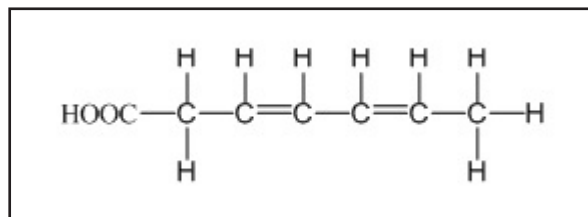
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3. **Figure 3** is an example of the structural formula of a polyunsaturated fat which can undergo the process of hydrogenation.

Figure 3



Explain clearly the effects of hydrogenation on the polyunsaturated fat.

Skill level 3

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4. Two possible products could be produced when propene reacts with hydrogen bromide(aq).

Describe how you identified the major product in the above reaction.

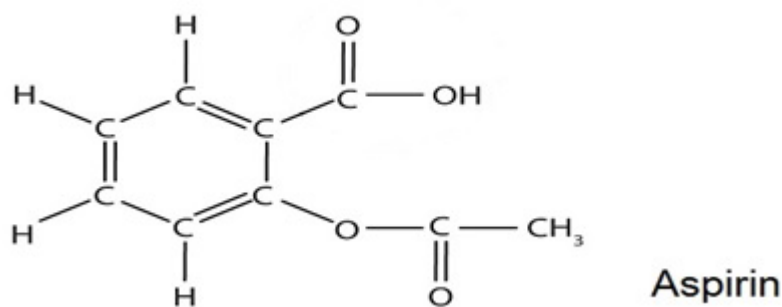
Skill level 2	
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5. A chemistry class studied the chemistry of alcohols. They carried out an experiment on the reaction of acidified potassium dichromate with 2-propanol.

Name the products formed from the reaction above.

Skill level 2	
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6. Tablets for treating headaches and other body pains often contain aspirin. The structural formula of aspirin is:



Source: <https://www.google.com/search?q=aspirin+chemical+structure&tbm>

Describe how an aspirin, which is an ester, is formed from ethanoic acid.

Skill level 2	
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With your **knowledge of solubilities**, discuss the tests for the presence of the two unknown solutions and describe what observations will be made.

[illegible]

Skill level 4	
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QUESTION SIX:**REDOX CHEMISTRY**

Police officers patrol mostly during Friday and Saturday evenings and sometimes late at night. One of the main reasons for their patrol is to ensure drivers are not drunk with alcohol. A breathalyzer test is used, where drivers exhale through the mouthpiece of the alcohol testing equipment into a test chamber filled with a reddish-orange solution of acidified potassium dichromate ($\text{K}_2\text{Cr}_2\text{O}_7$).

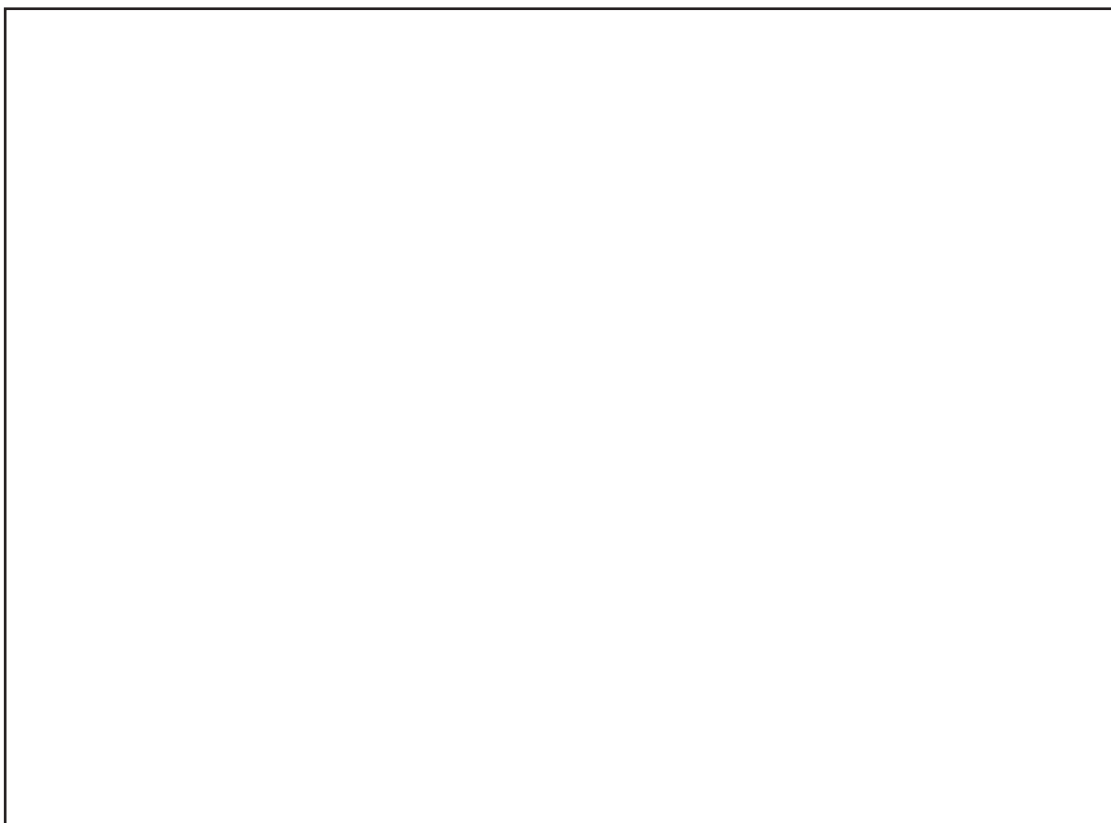


Source: <https://www.google.com/search?q=breathalyser+test>

1. Write a full **balanced chemical equation** for the breathalyzer test reaction.

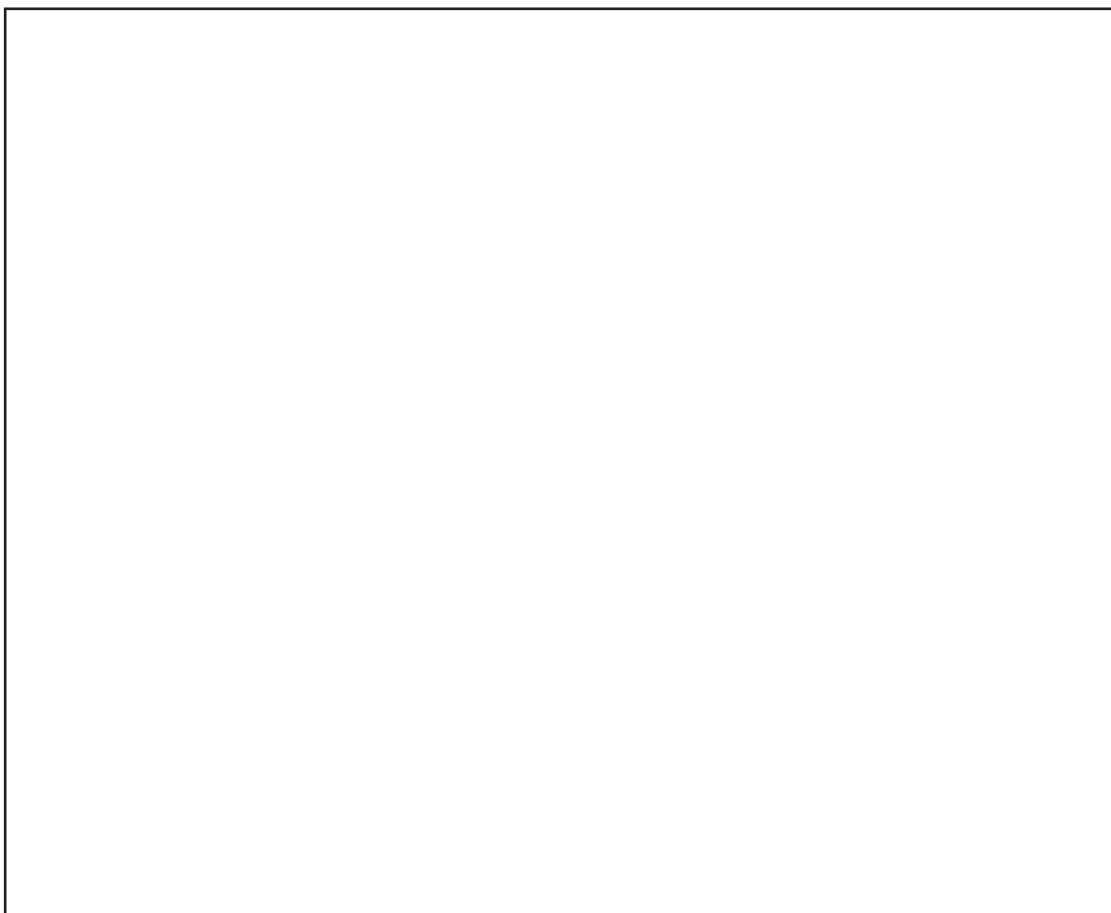
Skill level 3	
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2. In industries, sodium chloride undergoes electrolysis for the production of many purities.
- a. Draw a labelled diagram on the electrolysis of **molten** sodium chloride.



Skill level 2	
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- b. Write the overall **balanced chemical equation** for the electrolysis of a **diluted** sodium chloride solution.



Skill level 3	
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QUESTION SEVEN:**QUANTITATIVE CHEMISTRY**

1. Oxalic acid is a toxic substance used in laundries to remove rust stains. Its composition is 26.7% carbon, 2.2% hydrogen and 71.1% oxygen by mass. Its molar mass is 90 g mol^{-1} .

[Given: $M(\text{C}) = 12 \text{ g mol}^{-1}$, $M(\text{O}) = 16 \text{ g mol}^{-1}$ and $M(\text{H}) = 1 \text{ g mol}^{-1}$]

Determine the empirical formula of oxalic acid.

Skill level 2	
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VIII

$$=$$

57	58	59	60	61	62	63	64	65	66	67	68	69	70
La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb
138.91	140.12	140.91	144.24	146.92	150.35	151.96	157.25	158.92	162.50	164.93	167.26	168.93	173.04
89	90	91	92	93	94	95	96	97	98	99	100	101	102
Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No
227.03	232.04	231.04	238.08	237.05	239.05	241.06	247.07	249.08	251.08	254.09	257.10	258.10	256