| MARKER CODE | | | | |
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| STUDENT ENROLMENT NUMBER | | | | | | | | | |
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# Tonga National Form Seven Certificate

# CHEMISTRY

# 2016

## QUESTION and ANSWER BOOKLET

Time allowed: Two Hours

### INSTRUCTIONS

1. Write your **STUDENT ENROLMENT NUMBER (SEN)** on the top right hand corner of this booklet.
2. Answer ALL QUESTIONS. Write your answers in the spaces provided in this booklet.
3. If you need more space for answers, ask the Supervisor for extra paper. Write your **SEN** on all extra sheets used and clearly number the questions. Attach the extra sheets at the appropriate places in this booklet.

| QUESTIONS AND TOPICS | | Pages | Time (mins) | Total |
|---|---|---|---|---|
| **SECTION A – MULTIPLE CHOICE QUESTIONS** | | **2** | **24** | **5** |
| **SECTION B – SHORT ANSWER QUETIONS** | | **3 -15** | **96** | **70** |
| **QUESTION 1** | **ATOMIC STRUCTURE , BONDING & RELATED PROPERTIES** | 3-4 | 16 | 10 |
| **QUESTION 2** | **EQUILIBRIUM AND ENERGETICS OF PHYSICAL AND CHEMICAL PROCESSES** | 5-6 | 16 | 10 |
| **QUESTION 3** | **REDOX REACTIONS AND ORGANIC CHEMISTRY** | 7-8 | 16 | 10 |
| **QUESTION 4** | **EQUILIBRIUM AND ORGANIC CHEMISTRY** | 9 - 10 | 16 | 10 |
| **QUESTION 5** | **EQUILIBRIUM AND ORGANIC CHEMISTRY** | 11 | 16 | 10 |
| **QUESTION 6** | **EQUILIBRIUM AND ORGRANIC CHEMISTRY** | 12 - 13 | 16 | 10 |
| **QUESTION 7** | **EQUILIBRIUM AND THE ENERGETICS OF PHYSICAL AND CHEMICAL PROCESSES** | 14-15 | 16 | 10 |
| **TOTAL** | | **19** | **120** | **75** |

Check that this booklet contains pages 2-19 in the correct order. Page 16-,18,19 has been deliberately left blank.

Show all working. Unless otherwise stated, numerical answers correct to three significant figure. Periodic table has been provided at the end of the booklet. (page 17)

**YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.**

## SECTION A MULTIPLE CHOICE QUESTIONS

Write the **LETTER** of your choice on the appropriate box at the side of each question.

**Question 1:**

Nuclear fission is the process where_____.

A. small parts come together to form a large mass
B. a large nucleus breaks up into two smaller nuclei
C. multiple atoms combine to form a large atom
D. a huge nuclear breaks up giving off a lot of ice

| Skill level 1 | |
|---|---|
| 1 | |
| 0 | |
| NR | |

**Question 2:**

The enthalpy change that occurs in a system when one mole of matter is transformed by a chemical reaction under standard condition is called:

A. Standard enthalpy of reaction.
B. Standard enthalpy of combustion.
C. Standard enthalpy of fusion.
D. Enthalpy of vapourisation.

| Skill level 1 | |
|---|---|
| 1 | |
| 0 | |
| NR | |

**Question 3:**

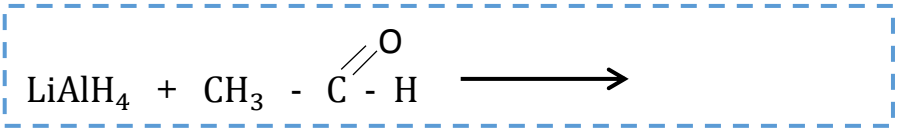
Which **ONE (1)** of the following equations is a redox reaction?

A. $NaOH + HCl \longrightarrow H_2O + NaCl$
B. $KCl + AgNO_3 \longrightarrow AgCl + KNO_3$
C. $Mg + AlCl_3 \longrightarrow MgCl_3 + Al$
D. $2C_2H_6 + 7O_2 \longrightarrow 4CO_2 + 6H_2O$

| Skill level 1 | |
|---|---|
| 1 | |
| 0 | |
| NR | |

**Question 4:**

Which of the following is the product of the following reaction?



A. $CH_3COOH$
B. $CH_3CO$
C. $CH_3COH$
D. $CH_2COOH$

| Skill level 2 | |
|---|---|
| 2 | |
| 1 | |
| 0 | |
| NR | |

## Section B: Short Answer Questions

Answer All Questions Of This Section On The Spaces Provided.

**Question 1: Atomic Structure, Bonding & Related properties.**

a. Draw the Lewis Structure of Carbon Dioxide.

| Skill level 2 | |
|---|---|
| 2 | |
| 1 | |
| 0 | |
| NR | |

b. Write the ground state electron configuration of Chromium using the s, p, d and f notation.

| Skill level 2 | |
|---|---|
| 2 | |
| 1 | |
| 0 | |
| NR | |

c. Differentiate between the fission and the fusion reactions.

| Skill level 3 | |
|---|---|
| 3 | |
| 2 | |
| 1 | |
| 0 | |
| NR | |

d. Find the pH during the titration of 20ml of 0.10M butanoic acid, $CH_3CH_2\ CH_2COOH$ ($Ka = 1.54 \times 10^{-5}$) with 0.10 M NaOH solution and the appropriate indicator after the following additions of titrants: 0 mL and 25mL.

| Skill level 3 | |
|---|---|
| 3 | |
| 2 | |
| 1 | |
| 0 | |
| NR | |

**Question 2: Equilibrium and the Energetics of Physical and Chemical Processes**

a. Calculate the ΔH° for the reaction:

$$2H_2S(g) + 3O_2(g) \longrightarrow SO_2(g) + H_2O\ (g)$$

Given:

**Standard Enthalpies of Formation at 25°C**

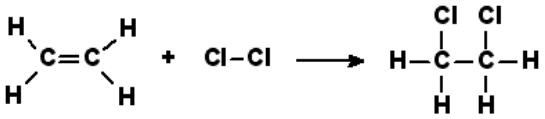
| **Formula** | $\Delta H^{\circ}(\frac{KJ}{mol})$ |
|---|---|
| $H_2O$ (g) | -241.8 |
| $O_2$ (g) | 0 |
| $SO_2$ (g) | -297 |
| $H_2S$ (g) | -21 |

| Skill level 2 | |
|---|---|
| 2 | |
| 1 | |
| 0 | |
| NR | |

b. Use the given bond energies to calculate the enthalpy of reaction, of Ethene and Chlorine

**Average Bond Energies:**

| **Bond** | **Bond Energy (KJ/mol)** |
|---|---|
| C – H | 413 |
| C – Cl | 339 |
| Cl – Cl | 243 |
| C = C | 614 |
| C – C | 347 |




| Skill level 2 | |
|---|---|
| 2 | |
| 1 | |
| 0 | |
| NR | |

c. Differentiate between the endothermic and exothermic reactions in relation to the bond making and bond breaking processes and give the appropriate examples of these.

| Skill level 3 | |
|---|---|
| 3 | |
| 2 | |
| 1 | |
| 0 | |
| NR | |

d. Determine which of the following electrolytes is stronger and support your answer with the relevant equation and calculations.

0.1 M of $CH_3COOH$ and 0.1M of HCl.

Ka $=1.8 \times 10^{-5}$ Ka $=1.3 \times 10^{6}$

| Skill level 3 | |
|---|---|
| 3 | |
| 2 | |
| 1 | |
| 0 | |
| NR | |

**Question 3: Redox Reactions and Organic Chemistry**

a. An electrochemical cell is set up based on the reaction nickel metal and hydrogen peroxide.

$$E°(H_2O_2/H_2O) = +1.77\ V$$
$$E°(Ni^{2+}/Ni) = -0.62\ V$$

i. This reaction is to be used in an electrochemical cell.

Complete the standard cell diagram below for the cell.

| Skill level 2 | |
|---|---|
| 2 | |
| 1 | |
| 0 | |
| NR | |

ii. Explain how the electrochemical cell in i. can be used in everyday life, giving its applications and limitations.

| Skill level 3 | |
|---|---|
| 3 | |
| 2 | |
| 1 | |
| 0 | |
| NR | |

b. Draw and name **TWO** (2) structural formulae of the isomers of Butene.

| Skill level 2 | |
|---|---|
| 2 | |
| 1 | |
| 0 | |
| NR | |

c. Describe the structure of polyethylene and identify its properties in relation to its structure.

| Skill level 3 | |
|---|---|
| 3 | |
| 2 | |
| 1 | |
| 0 | |
| NR | |

**Question 4: Equilibrium & Organic Chemistry**

a. An unknown colourless organic solution is soluble in water and tested neutral with pH paper. The same liquid tested positive with the Lucas reagent. Identify the Unknown solution and explain how it may test positive with the Lucas reagent by the use of an equation.

| Skill level 3 | |
|---|---|
| 3 | |
| 2 | |
| 1 | |
| 0 | |
| NR | |

b. Calculate the molar solubility of $FeCO_3$(Ksp = $3.07 \text{ X } 10^{-11}$).

| Skill level 3 | |
|---|---|
| 3 | |
| 2 | |
| 1 | |
| 0 | |
| NR | |

c. Compare the solubility of AgCl in pure water, Ksp = $1.8\,X\,10^{-10}$ at 25° C and when $NH_3$(g) is added to the solution. Then account for the difference. $K_f$ of $Ag(NH_3)_2^+$ = $1.6\ x\,10^6$.

| Skill level 4 | |
|---|---|
| 4 | |
| 3 | |
| 2 | |
| 1 | |
| 0 | |
| NR | |

**Question 5: Equilibrium and Organic Chemistry**

a. Describe the reaction of ethanol with concentrated sulfuric acid using a balanced equation.

| Skill level 2 | |
|---|---|
| 2 | |
| 1 | |
| 0 | |
| NR | |

b. Write the chemical reaction to describe the reaction of ethanoyl Chloride and propanol.

| Skill level 2 | |
|---|---|
| 2 | |
| 1 | |
| 0 | |
| NR | |

c. Describe the hydrolysis reaction of ethyl butanoate include all conditions the reaction takes place in.

| Skill level 2 | |
|---|---|
| 2 | |
| 1 | |
| 0 | |
| NR | |

d. Discuss and analyse **THREE** (3) factors which can affect the equilibrium position of a reaction using specific examples.

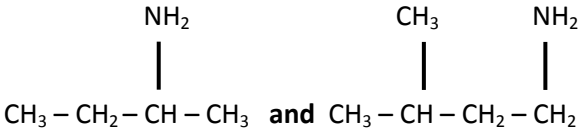
| Skill level 4 | |
|---|---|
| 4 | |
| 3 | |
| 2 | |
| 1 | |
| 0 | |
| NR | |

**Question 6: Equilibrium and Organic Chemistry**

a. Describe the buffer solution including when weak acid or base is added to it using the relevant equations.

| Skill level 2 | |
|---|---|
| 2 | |
| 1 | |
| 0 | |
| NR | |

b. Use the IUPAC rules to name the following amine isomers.




| Skill level 2 | |
|---|---|
| 2 | |
| 1 | |
| 0 | |
| NR | |

c. Explain how the structure of an organic compound determines the reactions it is involved in, use an ester as an example.

| Skill level 3 | |
|---|---|
| 3 | |
| 2 | |
| 1 | |
| 0 | |
| NR | |

d. Explain how water management practices (supply, irrigation and runoff) are used to maintain sustainable production.

| Skill level 3 | |
|---|---|
| 3 | |
| 2 | |
| 1 | |
| 0 | |
| NR | |

**Question 7** **Equilibrium and Energetics of Physical and Chemical Processes.**

a. Define Enthalpy change.

| Skill level 1 | |
|---|---|
| 1 | |
| 0 | |
| NR | |

b. Find the ΔH in Kilo Joules for:

$Ca(s) + ½\ O_2\ (g) + CO_2\ (g) \longrightarrow CaCO_3\ (s)$

Given the following reactions:

$Ca(s) + ½\ O_2\ (g) \longrightarrow CaO\ (s)$ $\Delta H = -635$ KJ

$CaCO_3\ (s) \longrightarrow CaO\ (s) + CO_2\ (g)$ $\Delta H = 178$ KJ

| Skill level 2 | |
|---|---|
| 2 | |
| 1 | |
| 0 | |
| NR | |

c. Propanoic acid ($CH_3CH_2COOH$, which we will simplify as HPr) is a carboxylic acid whose salts are used to retard mold growth in foods. Calculate the $[H_2O^+]$ of 0.10 M HPr ($K_a = 1.3 \times 10^{-5}$).

| Skill level 2 | |
|---|---|
| 2 | |
| 1 | |
| 0 | |
| NR | |

d. Draw the structural formula of the substance that will be formed in the reaction between $K_2Cr_2O_7$ and $CH_3CO\,H_2CH_3$ in an acidic medium.

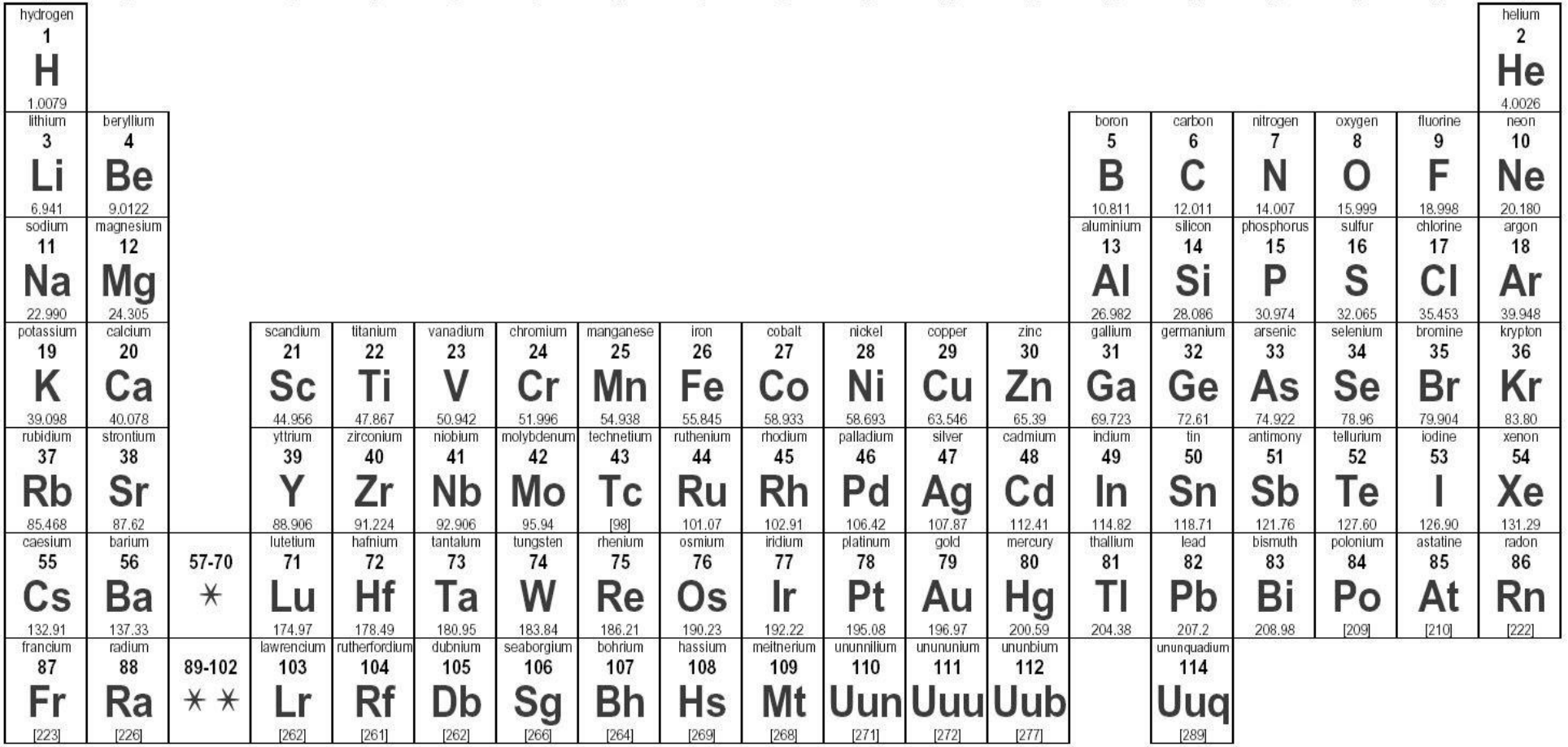
| Skill level 2 | |
|---|---|
| 2 | |
| 1 | |
| 0 | |
| NR | |

e. The boiling points of ammonia $NH_3$, fluorine, $F_2$ , and hydrogen chloride, HCl, are given in the table below.

| **Molecule** | **Boiling point / °C** |
|---|---|
| Ammonia, $NH_3$ | -33 |
| Fluorine, $F_2$ | -188 |
| Hydrogen Chloride HCl | -85 |

Discuss the differences between the boiling points of $NH_3$, $F_2$ and HCl, in terms of the strength of the attractive forces between the particles involved.

| Skill level 3 | |
|---|---|
| 3 | |
| 2 | |
| 1 | |
| 0 | |
| NR | |


hydrogen 1 H 1.0079
helium 2 He 4.0026
lithium 3 Li 6.941
beryllium 4 Be 9.0122
boron 5 B 10.811
carbon 6 C 12.011
nitrogen 7 N 14.007
oxygen 8 O 15.999
fluorine 9 F 18.998
neon 10 Ne 20.180
sodium 11 Na 22.990
magnesium 12 Mg 24.305
aluminium 13 Al 26.982
silicon 14 Si 28.086
phosphorus 15 P 30.974
sulfur 16 S 32.065
chlorine 17 Cl 35.453
argon 18 Ar 39.948
potassium 19 K 39.098
calcium 20 Ca 40.078
scandium 21 Sc 44.956
titanium 22 Ti 47.867
vanadium 23 V 50.942
chromium 24 Cr 51.996
manganese 25 Mn 54.938
iron 26 Fe 55.845
cobalt 27 Co 58.933
nickel 28 Ni 58.693
copper 29 Cu 63.546
zinc 30 Zn 65.39
gallium 31 Ga 69.723
germanium 32 Ge 72.61
arsenic 33 As 74.922
selenium 34 Se 78.96
bromine 35 Br 79.904
krypton 36 Kr 83.80
rubidium 37 Rb 85.468
strontium 38 Sr 87.62
yttrium 39 Y 88.906
zirconium 40 Zr 91.224
niobium 41 Nb 92.906
molybdenum 42 Mo 95.94
technetium 43 Tc [98]
ruthenium 44 Ru 101.07
rhodium 45 Rh 102.91
palladium 46 Pd 106.42
silver 47 Ag 107.87
cadmium 48 Cd 112.41
indium 49 In 114.82
tin 50 Sn 118.71
antimony 51 Sb 121.76
tellurium 52 Te 127.60
iodine 53 I 126.90
xenon 54 Xe 131.29
caesium 55 Cs 132.91
barium 56 Ba 137.33
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hafnium 72 Hf 178.49
tantalum 73 Ta 180.95
tungsten 74 W 183.84
rhenium 75 Re 186.21
osmium 76 Os 190.23
iridium 77 Ir 192.22
platinum 78 Pt 195.08
gold 79 Au 196.97
mercury 80 Hg 200.59
thallium 81 Tl 204.38
lead 82 Pb 207.2
bismuth 83 Bi 208.98
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bohrium 107 Bh [264]
hassium 108 Hs [269]
meitnerium 109 Mt [268]
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unununium 111 Uuu [272]
ununbium 112 Uub [277]
ununquadium 114 Uuq [289]
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cerium 58 Ce 140.12
praseodymium 59 Pr 140.91
neodymium 60 Nd 144.24
promethium 61 Pm [145]
samarium 62 Sm 150.36
europium 63 Eu 151.96
gadolinium 64 Gd 157.25
terbium 65 Tb 158.93
dysprosium 66 Dy 162.50
holmium 67 Ho 164.93
erbium 68 Er 167.26
thulium 69 Tm 168.93
ytterbium 70 Yb 173.04
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neptunium 93 Np [237]
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americium 95 Am [243]
curium 96 Cm [247]
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mendelevium 101 Md [258]
nobelium 102 No [259]

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