education

Department:
Education
PROVINCE OF KWAZULU-NATAL

PHYSICAL SCIENCE: CHEMISTRY (P2)

COMMON TEST

JUNE 2018

NATIONAL
SENIOR CERTIFICATE

GRADE 10

MARKS: 100

TIME: 2 hours

This question paper consists of 11 pages and a Periodic Table.

Please turn over

INSTRUCTIONS AND INFORMATION

1. This question paper consists of EIGHT questions. Answer ALL the questions in the ANSWER BOOK.

2. Number the answers correctly according to the numbering system used in this question paper.

3. Leave ONE line between two sub questions, for example between QUESTION 2.1 and QUESTION 2.2.

4. You may use a non-programmable calculator.

5. You may use appropriate mathematical instruments.

6. YOU ARE ADVISED TO USE THE ATTACHED DATA SHEET.

7. Show ALL formulae and substitutions in ALL calculations.

8. Round off your FINAL numerical answers to a minimum to TWO decimal places.

9. Give brief motivations, discussions, et cetera where required.

10. Write neatly and legibly.

QUESTION 1: MULTIPLE- CHOICE

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Write down only the letter (A – D) next to the question number (1.1 – 1.7) in the answer book, for example 1.8 D.

1.1   Which term describes ability of metals to stretch into thin wires?

    A   Brittle
    B   Ductile
    C   Malleable
    D   Tensile strength   (2)

1.2   Silicon can be classified as a…
    A   Metal
    B   Metalloid
    C   Non metal
    D   transition metal   (2)

1.3.   Solid carbon dioxide turns directly into a gas at room temperature. This process is called...
    A   Boiling
    B   Deposition
    C   Sublimation
    D   Evaporation   (2)

1.4.   The type of bond where both the bonding electrons come from the same atom is described as a/ an …
    A   Ionic Bond
    B   Dative bond
    C   Covalent bond
    D   Metallic bond   (2)

1.5   Which one of the following reactions can be classified as REDOX reaction?

    A $Zn(s) + 2HC\ell(aq) \rightarrow ZnC\ell_2(aq) + H_2(g)$

    B $KC\ell(aq) + AgNO_3(aq) \rightarrow KNO_3(aq) + AgC\ell(s)$

    C $Cu^{2+}(aq) + O^{2-}(aq) \rightarrow CuO(s)$

    D $ZnC\ell_2(aq) + CaSO_4(aq) \rightarrow ZnSO_4(aq) + CaC\ell_2(aq)$ (2)

1.6   The energy released when an electron is added to an atom or molecule is
    called …

    A   Electronegativity

    B   Electron affinity

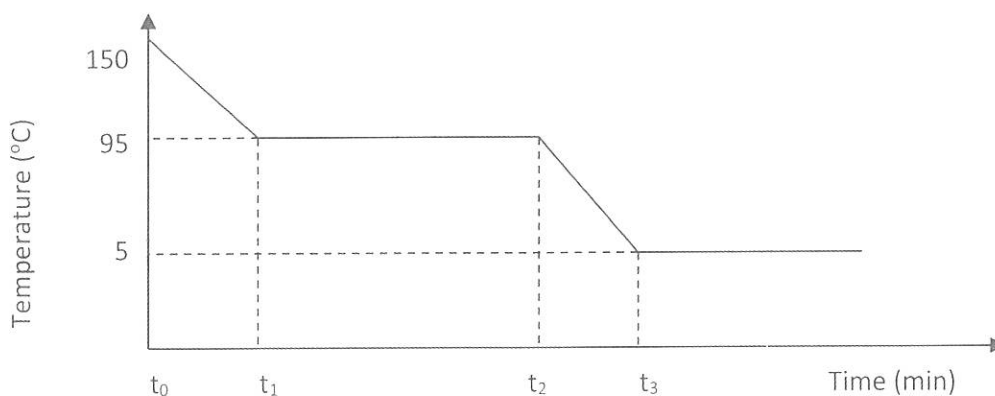   C   Enthalpy change

    D   Ionisation energy   (2)

1.7.   The separation technique most suitable for the separation of an oil-water mixture
    in the laboratory is…

    A   Decanting

    B   Chromatography

    C   Magnetic attraction

    D   Fractional Distillation   (2)

                                                  [14]

QUESTION 2

2.1 The following graph, not drawn to scale, represents the cooling curve of a substance with a boiling point of 95°C.

2.1.1 Define **temperature.** (2)

2.1.2 Name the phase of the substance between times t_0 and t_1. (1)

2.1.3 Write down the freezing point of this substance. (1)

2.1.4 Name the process taking place between times t_1 and t_2. (1)

2.1.5 Use Kinetic Molecular theory to explain the process mentioned in question 2.1.4. (2)

2.1.6 In what state of matter is the substance after time t_3? (1)

2.2 Consider the following statements, and answer questions that follow:

i.   Boiling is the same as evaporation due to associated phase change.

li   Evaporation and boiling have the same phase change, but boiling occurs at specific temperature.

2.2.1 Define **boiling point.** (2)

2.2.2 Which statement is correct? Explain. (3)

[13]

QUESTION 3

3.1. Study the following processes and answer the questions that follow:

$$A: \quad H_2O_{(s)} \xrightarrow{\text{Heat}} H_2O_{(g)}$$

$$B: \quad C + O_{2(s)} \xrightarrow[\text{Heat}]{} CO_{2(g)}$$
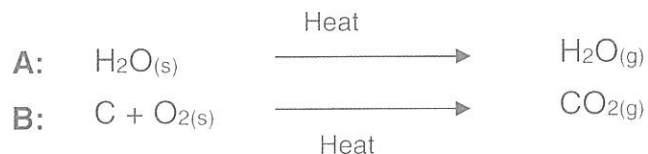
3.1.1 Identify the process that represents a chemical change. (1)

3.1.2 Identify the process that represents a physical change. (1)

3.1.3 Are the above processes endothermic or exothermic? Provide a reason (2) for the answer.

3.2 Name the following compounds
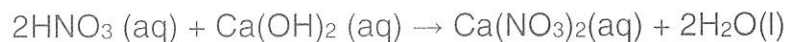
3.2.1 HBr (1)

3.2.2 CCl_4 (2)

3.2.3 $Na_2S_2O_3$ (2)

3.3 Balance the following reactions:

3.3.1 $Fe + O_2 \rightarrow Fe_2O_3$ (2)

3.3.2 $C_2H_6 + O_2 \rightarrow CO_2 + H_2O$ (2)

3.3.3 $Na_2SO_4 + Ba(NO_3)_2 \rightarrow BaSO_4 + NaNO_3$ (2)

3.4 Consider the following chemical reaction:

$$2HNO_3 \text{ (aq)} + Ca(OH)_2 \text{ (aq)} \rightarrow Ca(NO_3)_2(aq) + 2H_2O(l)$$

3.4.1 State the law of conservation of mass. (2)

3.4.2 Show that the reaction obeys the law of conservation of mass. (3)

[20]

QUESTION 4

4.1. Magnesium is an element, with an atomic number of 12 and naturally exists as isotopes.

4.1.1 What are isotopes? (1)

Magnesium consist of 3 naturally occurring isotopes, ^{24}Mg, ^{25}Mg and ^{26}Mg

Isotope	% abundance	Atomic Mass number
^{24}Mg	78.99	23,985
^{25}Mg		24.959
^{26}Mg	11.01	25,983

4.1.2 Name the group in which magnesium is found. (1)

4.1.3 Name the element that has the same number of electrons as there are core electrons in magnesium. (1)

4.1.4 Calculate the number of neutrons in ^{26}Mg. (1)

4.1.5 Calculate the percentage abundance of ^{25}Mg. (1)

4.1.6 Determine the relative atomic mass of Magnesium. (4)

4.2 Oxygen exists naturally as a diatomic molecule:

4.2.1 What is a *diatomic molecule*? (2)

4.2.2 Give the valency of oxygen in its natural state. (1)

4.2.3 State Pauli's Exclusion Principle. (2)

4.2.4 Write down the electronic configuration for the oxygen atom. (2)

4.2.5 Name the type of bonding that takes place in the oxygen molecule. (1)

[17]

QUESTION 5

5.1 Define an *ionic bond*. (2)

5.2 Draw the Lewis structures for the following substances.

  5.2.1 CO_2 (2)

  5.2.2 NH_3 (2)

                            [6]

QUESTION 6

Grade 10 learners carry out two chemical reactions in aqueous solutions.

Test tube A has a solution of sodium carbonate and test tube B has a solution of sodium sulphate.

Into each test tube a small amount of barium chloride solution is added.
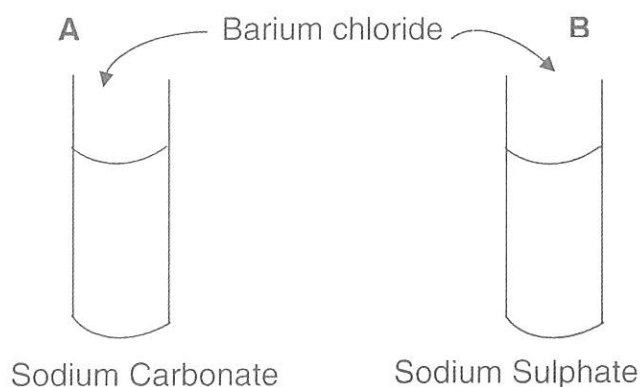
The results are shown in the table below.

Test tubes	Reagents	Observations
A.	$BaCl_2$ (aq) and Na_2CO_3(aq)	White solid forms
B.	$BaCl_2$ (aq) and Na_2SO_4(aq)	White solid forms

6.1 What is meant by an *aqueous solution*? (1)

6.2 Name the type of reaction taking place in both test tubes (1)

6.3 Write down the chemical formula of the salt produced in test tube A. (2)

6.4   Nitric acid, HNO_3, is now added to both test tubes.

State the observable changes that take place in:

6.4.1   test tube A   (1)

6.4.2   test tube B   (1)

6.5   Write down the balanced equation for the reaction that explains the observation in question 6.4.   (3)

[9]

QUESTION 7

Two solutions are provided as shown below:

A

Sugar Solution

B

Sodium Chloride Solution
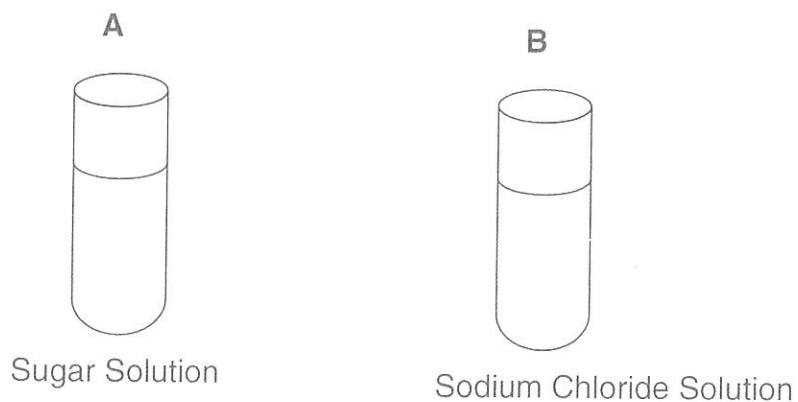
7.1.   Define a *solution*.   (2)

7.2   Write down the chemical formula for sodium chloride.   (1)

7.3   Give a common name for sodium chloride.   (1)

7.4   The following experimental set up is used to determine the electrical conductivity of the above solutions
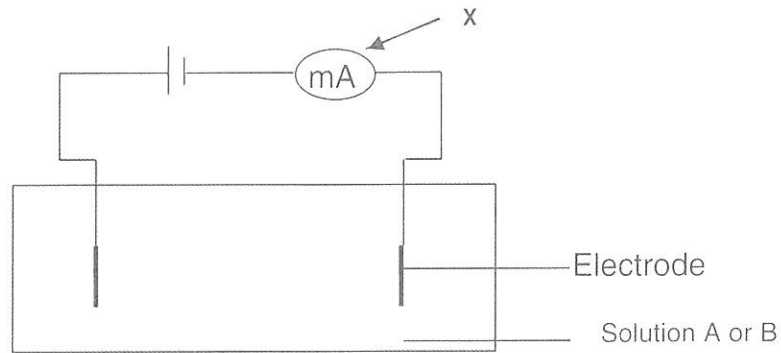
7.4.1   What physical quantity is measured by component X?   (1)

7.4.2   Define an **electrolyte**.   (2)

7.4.3   Identify the solution (**A or B**) that will give a reading on X? Give a reason   (2)

7.4.4   How would an INCREASE in CONCENTRATION of the solution identified in question 7.4.3 affect the reading on X?

(Choose from: **INCREASES; DECREASES or REMAINS THE SAME**)

Explain?   (3)

           [12]

QUESTION 8

8.1 The graph below shows the first ionization energies of group 2 elements.
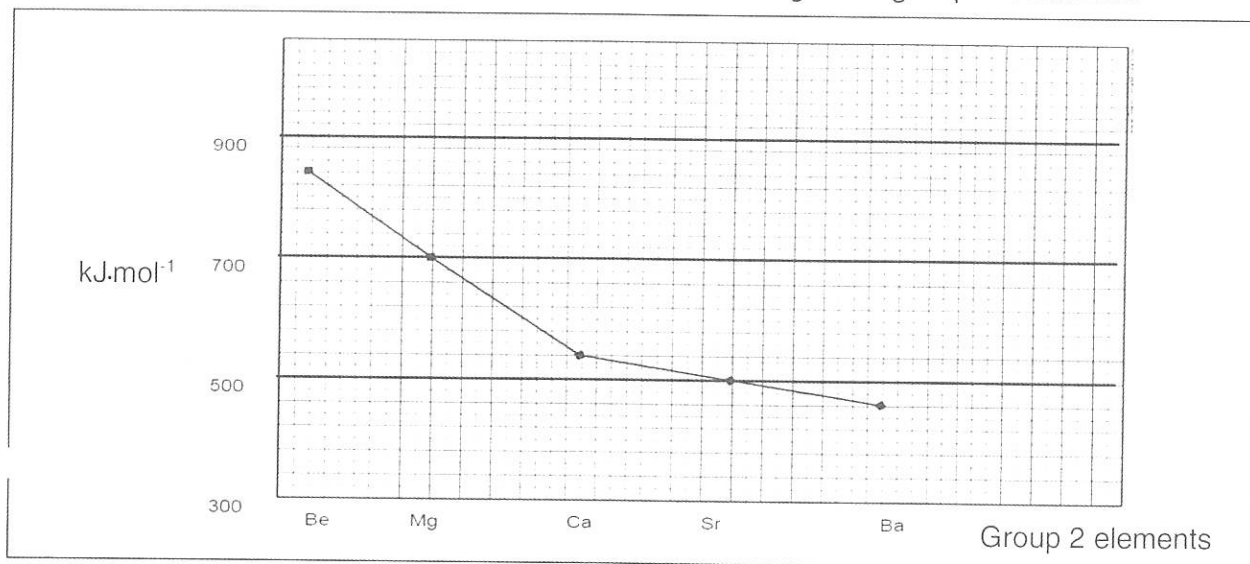
8.1.1 Define *first ionization energy*. (2)

8.1.2 Describe the trend in the first ionization energies, of group 2 elements. (2)

8.2. The first ionization energy of Na (Sodium) is 496 kJ.mol^{-1}, whilst the first ionization energy of Mg (magnesium) is 738 kJ.mol^{-1}.

Explain this difference. (3)

8.3 For each of the following questions, choose from:

INCREASES, DECREASES, REMAINS THE SAME

8.3.1 How does the atomic radius change on going across a period? (1)

8.3.2 How does the electronegativity change on going down a group? (1)

[9]

TOTAL MARKS: [100]

TABLE 3: THE PERIODIC TABLE OF ELEMENTS

KEY/SLEUTEL

Atomic number
Atoomgetal

Symbol
Simbool

Electronegativity
Elektronegatiwiteit

Approximate relative atomic mass
Benaderde relatiewe atoommassa

29
1,9 **Cu**
63,5

1 (I)	2 (II)	3	4	5	6	7	8	9	10	11	12	13 (III)	14 (IV)	15 (V)	16 (VI)	17 (VII)	18 (VIII)
2,1 **H** 1 1																	2 **He** 4
1,0 **Li** 3 7	1,5 **Be** 4 9											2,0 **B** 5 11	2,5 **C** 6 12	3,0 **N** 7 14	3,5 **O** 8 16	4,0 **F** 9 19	10 **Ne** 20
0,9 **Na** 11 23	1,2 **Mg** 12 24											1,5 **Aℓ** 13 27	1,8 **Si** 14 28	2,1 **P** 15 31	2,5 **S** 16 32	3,0 **Cℓ** 17 35,5	18 **Ar** 40
0,8 **K** 19 39	1,0 **Ca** 20 40	1,3 **Sc** 21 45	1,5 **Ti** 22 48	1,6 **V** 23 51	1,6 **Cr** 24 52	1,5 **Mn** 25 55	1,8 **Fe** 26 56	1,8 **Co** 27 59	1,8 **Ni** 28 59	1,9 **Cu** 29 63,5	1,6 **Zn** 30 65	1,6 **Ga** 31 70	1,8 **Ge** 32 73	2,0 **As** 33 75	2,4 **Se** 34 79	2,8 **Br** 35 80	36 **Kr** 84
0,8 **Rb** 37 86	1,0 **Sr** 38 88	1,2 **Y** 39 89	1,4 **Zr** 40 91	**Nb** 41 92	1,8 **Mo** 42 96	**Tc** 43	2,2 **Ru** 44 101	2,2 **Rh** 45 103	2,2 **Pd** 46 106	1,9 **Ag** 47 108	1,7 **Cd** 48 112	1,7 **In** 49 115	1,8 **Sn** 50 119	1,9 **Sb** 51 122	2,1 **Te** 52 128	2,5 **I** 53 127	54 **Xe** 131
0,7 **Cs** 55 133	0,9 **Ba** 56 137	1,6 **La** 57 139	1,6 **Hf** 72 179	**Ta** 73 181	**W** 74 184	**Re** 75 186	**Os** 76 190	**Ir** 77 192	**Pt** 78 195	**Au** 79 197	**Hg** 80 201	1,8 **Tℓ** 81 204	1,8 **Pb** 82 207	1,9 **Bi** 83 209	2,0 **Po** 84	2,5 **At** 85	86 **Rn**
0,7 **Fr** 87	0,9 **Ra** 88 226	**Ac** 89															

58 **Ce** 140	59 **Pr** 141	60 **Nd** 144	61 **Pm**	62 **Sm** 150	63 **Eu** 152	64 **Gd** 157	65 **Tb** 159	66 **Dy** 163	67 **Ho** 165	68 **Er** 167	69 **Tm** 169	70 **Yb** 173	71 **Lu** 175
90 **Th** 232	91 **Pa**	92 **U** 238	93 **Np**	94 **Pu**	95 **Am**	96 **Cm**	97 **Bk**	98 **Cf**	99 **Es**	100 **Fm**	101 **Md**	102 **No**	103 **Lr**

PHYSICAL SCIENCES P2
(CHEMISTRY)

COMMON TEST

JUNE 2018

MARKING GUIDELINE

NATIONAL
SENIOR CERTIFICATE

GRADE 10

MARKS: 100

TIME :   2 hours

This marking guideline consists of 6 pages.

SECTION A

QUESTION 1

1.1   B ✓✓   (2)

1.2   B ✓✓   (2)

1.3   C ✓✓   (2)

1.4   B ✓✓   (2)

1.5   A ✓✓   (2)

1.6   B ✓✓   (2)

1.7   A ✓✓   (2)
                                                                                                     [14]

QUESTION 2

2.1.1   Temperature is the measure of the average kinetic energy of the particles ✓✓
        (2 or 0)   (2)

2.1.2   Gaseous ✓   (1)

2.1.3   5°C✓   (1)

2.1.4   Condensation ✓   (1)

2.1.5   ▪ As the temperature decreases kinetic energy of molecules decrease✓
        ▪ Attractive forces between molecules increase ✓   (2)

2.1.6   solid✓   (1)

2.2.1   Boiling point is the temperature of a liquid at which its vapour pressure equals
        the external (atmospheric) pressure. ✓✓ (2 or 0)   (2)

2.2.2   Statement II.✓   (3)
        ▪ Boiling is the change in phase of a liquid to gas at a <u>fixed temperature</u>✓
        ▪ Evaporation is the change in phase of a substance from a liquid to gas as
          <u>any temperature.</u> ✓
                                                                                                     [13]

QUESTION 3

3.1.1 B✓ (1)

3.1.2 A✓ (1)

3.1.3 Endothermic✓, in both processes heat energy was added. ✓ (2)

3.2.1 Hydrogen bromide ✓ (1)

3.2.2 Carbon tetrachloride✓✓ (2)

3.2.3 Sodium thiosaphate ✓✓ (2)

3.3.1 $4Fe + 3O_2$ ✓$\to 2Fe_2O_3$ ✓ (2)

3.3.2 $2C_2H_6 + 7O_2$ ✓$\to 4CO_2 + 6H_2O$✓ (2)

3.3.3 $Na_2SO_4 + Ba(NO_3)_2$ ✓$\to BaSO_4 + 2NaNO_3$ ✓ (2)

3.4.1 Matter cannot be created or destroyed but is transformed from one form to another✓✓ (2)

3.4.2 $M_{reactant}$ =2x1+2x14+2x3x16 + 40 + 2x16 +2x1 ✓= 160 g.mol⁻¹

$M_{products}$ =40 +2x14 +2x2x16 +2x2x1 +2x16 ✓= 160 g.mol⁻¹✓ (3)

[20]

QUESTION 4

4.1.1 Atoms of the same element (having the same number of protons), with different number of neutrons. ✓ (1)

4.1.2 Alkali Earth metals✓ (1)

4.1.3 Neon /Ne✓ (1)

4.1.4 N = 26 – 12 = 14 neutrons✓ (1)

4.1.5 %²⁵Mg = 100 – (78.99 +11.01)

= 10% ✓ (1)

4.1.6 $R.A.M. = \dfrac{M^{24}Mg \times \% \text{ abundance}}{100\%} + \dfrac{M^{25}Mg \times \% \text{ abundance}}{100\%} + \dfrac{M^{26}Mg \times \% \text{ abundance}}{100\%}$✓ (4)

$= \dfrac{23{,}985 \times 78{,}99}{100\%} + \dfrac{24{,}959 \times 10\%}{100\%} + \dfrac{25{,}983 \times 11{,}01\%}{100\%}$ ✓✓

$= 24.302$ g.mol⁻¹✓

4.2.1 Molecule that consist of 2 atoms from the same element. ✓✓ (2)

4.2.2 2 ✓ (1)

4.2.3 The maximum of 2 electrons in an orbital provided that they spin in opposite directions. ✓✓ (2)

4.2.4 $1s^12s^22p^4$ ✓✓ (2)

4.2.5 Covalent bond✓ (1)

[17]

QUESTION 5

5.1 An ionic bond is a chemical bond whereby electron(s) is transferred from one atom to the other✓ ✓ (2)

5.2.1

✓✓ (2)

5.2.2 　　　　　　　　　　　　　　　(2)

$$H \overset{xx}{\underset{\overset{x\bullet}{H}}{\overset{x\bullet}{N}}} \overset{\checkmark\checkmark}{H}$$

QUESTION 6

6.1　A solution where water is used as a solvent ✓　(1)

6.2　Precipitation✓　(1)

6.3　$BaCO_3$ ✓✓　(2)

6.4.1　Precipitate will dissolve ✓　(1)

6.4.2　No change. ✓　(1)

6.5　$Na_2CO_3 + 2HNO_3 \longrightarrow 2NaNO_3 + CO_2 + H_2O$ ✓✓✓　(3)

　　　　　　　　　　　　　　　　　　　　[9]

QUESTION 7

7.1　A solution is a homogeneous mixture of two or more substances ✓✓　(2)

7.2　NaCl✓　(1)

7.3　Table salt✓　(1)

7.4.1　Electric Current ✓　(1)

7.4.2　An electrolyte is a solution that conducts electricity through movement of ions.✓✓　(2)

7.4.3　B✓, contains ions in water✓　(2)

7.4.4　▪ (Ammeter) Increase✓
　　　▪ An increase in ionic concentration✓
　　　▪ increases the conductivity of a solution✓　(3)

　　　　　　　　　　　　　　　　　　　　[12]

QUESTION 8

8.1.1　Energy needed per mole to remove a mole of electrons from a mole of atoms in a gaseous phase. ✓✓　(2)

8.1.2　As one moves down the group ✓ ,First ionization energy decreases✓　(2)
　　　Or
　　　As one moves up the group ✓ ,First ionization energy increases✓

8.2　Na has 1 unpaired electron in 3s orbital✓. Mg has a pair of electrons in 3s orbital.✓ This represents greater stability. ✓ Therefore more energy needed in Mg.　(3)

8.3.1　Decreases✓　(1)

8.3.2　Decreases✓　(1)

　　　　　　　　　　　　　　　　　　　　[9]

　　　　　　　　　TOTAL MARKS:　　[100]