education

Department:
Education
PROVINCE OF KWAZULU-NATAL

NATIONAL SENIOR CERTIFICATE

GRADE 10

PHYSICAL SCIENCES: CHEMISTRY (P2)

COMMON TEST

JUNE 2019

MARKS: 100

TIME: 2 hours

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

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   The property of material to shape on hammering is called...   (2)

          A   Hard

          B   Brittle

          C   Ductile

          D   Malleable

1.2   The process whereby solid CO_2 changes to gas without forming a liquid is...   (2)

          A   Boiling

          B   Evaporation

          C   Sublimation

          D   Condensation

1.3.   The energy released when an electron is attached to an atom or molecule to   (2) form a negative ion is...

          A   Electron affinity

          B   Electronegativity

          C   Ionisation energy

          D   1st ionisation energy

1.4.   Which one of the following reactions can be classified as redox reaction?   (2)

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

          B $Zn(s) + 2HCl(aq) \rightarrow ZnCl_2(aq) + H_2(g)$

          C $KCl(aq) + AgNO_3(aq) \rightarrow KNO_3(aq) + AgCl(s)$

          D $ZnCl_2(aq) + CaSO_4(aq) \rightarrow ZnSO_4(aq) + CaCl_2(aq)$

                                           Please turn over

1.5.   The bond whereby there is a complete transfer of electron(s) from one atom to   (2)
       another is called...

       A   Ionic Bond
       B   Dative bond
       C   Metallic bond
       D   Covalent bond

1.6.   The chemical name for SO_4^{2-} is ...   (2)

       A   Sulphite ion
       B   Sulphide ion
       C   Sulphate ion
       D   Sulphur trioxide

1.7.   A Specific name given to an atom that has lost electron(s)   (2)

       A   Ion
       B   Atom
       C   Cation
       D   Anion

                                                                                         [14]

QUESTION 2

Si, water-ethanol, $CuSO_4$, Fe_2O_3, cooking oil- iron filings, Fe, Cl_2
---

2.1.   From above list identify the:

  2.1.1. Heterogeneous mixture   (1)

  2.1.2. Semi-metal.   (1)

  2.1.3. Compound.   (1)

  2.1.4. Rust.   (1)

  2.1.5. The substance that exists as a gas at room temperature.   (1)

2.2.   Now, consider thoroughly stirred water-ethanol at room temperature.

  2.2.1. Is this a homogeneous or heterogeneous mixture?   (2)
         Explain the answer.

  2.2.2. Name a suitable separation technique that can be used to separate   (1)
         water-ethanol mixture

  2.2.3. Name the physical property used in this technique mentioned in 2.2.2   (1)

  2.2.4. Which component of the mixture will be left behind?   (1)

  2.2.5. Why is this mixture considered *miscible*?   (2)

                                                                                 [12]

QUESTION 3

The two graphs (not drawn to scale) below represent the change in temperature of two substances, **X** and **Y**, when heated for a certain time. Both substances were in the solid phase at t = 0 minutes.
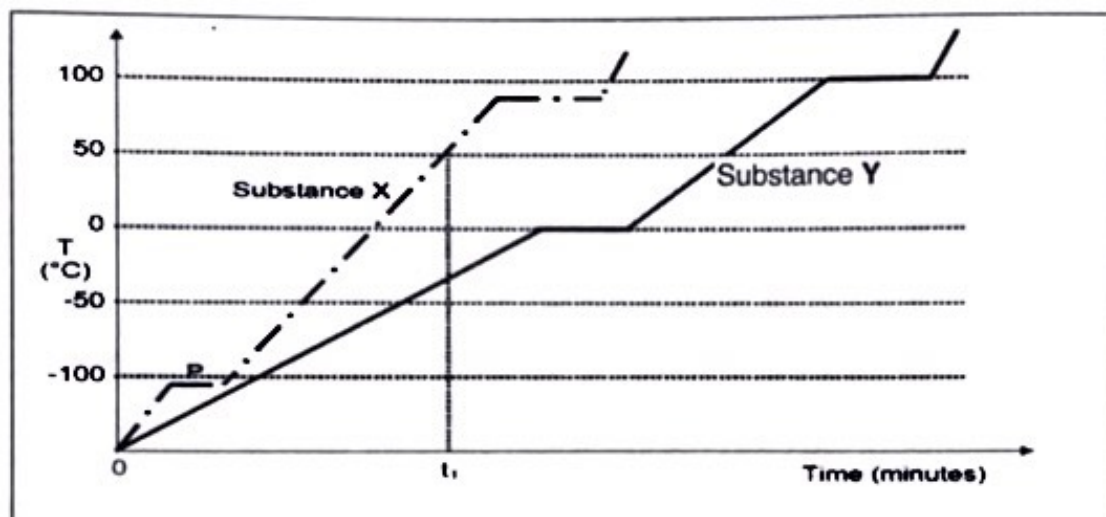
3.1.   Define *temperature*.   (2)

3.2   At t_1, write down the particle arrangement of:

      3.2.1. **X**   (1)

      3.2.2. **Y**   (1)

3.3.   Now, consider point **P** of substance **X**:

      3.3.1 Name the process taking place at **P**.   (1)

      3.3.2. There is no change in temperature. Explain why that is the case.   (2)

3.4.   At -50°C, write down the phase(s) of:

      3.4.1. **X**   (1)

      3.4.2. **Y**   (1)

3.5.   Is the boiling point of substance **X** HIGHER THAN, LOWER THAN or THE SAME   (1)
        AS the boiling point of substance **Y**?

3.6.   One of the substances from the above graphs is water.   (2)
        Which substance (**X** or **Y**) represents water? Explain the reason for the
        answer.

                                                                                        [12]

QUESTION 4

An element has the following electron configuration: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^3$

4.1   For the element write down the:

      4.1.1   Group number on the periodic table.   (2)
           Give a reason for the answer by referring to the above electron
           configuration.
      4.1.2   Period number in the periodic table.   (2)
           Give a reason for the answer by referring to the above electron
           configuration.

4.2.   Use Lewis structures to show the bond formation between   (3)
       aluminium ($A\ell$) and oxygen (O).

4.3.   A certain element, **Q**, is in-group VII of the periodic table.

       For this element, write down the:

      4.3.1. Name of the group.   (1)
      4.3.2. Normal valency.   (1)
      4.3.3. Number of valence electrons.   (1)
      4.3.4. Chemical equation that shows the formation of element **Q** ion.   (2)

4.4   The symbol notation for a certain element is:

$$^{31}_{15}X$$

      4.4.1. Draw the energy level (Aufbau) diagram.   (2)
      4.4.2   Write down the name of an element.   (1)

                                                                  [15]

QUESTION 5

Two unlabelled SODIUM compounds are found in the laboratory, but laboratory technician stated that only sulphate and carbonate were on the inventory.

Simplified experiment used to determine the sodium salts is shown in the diagram below:
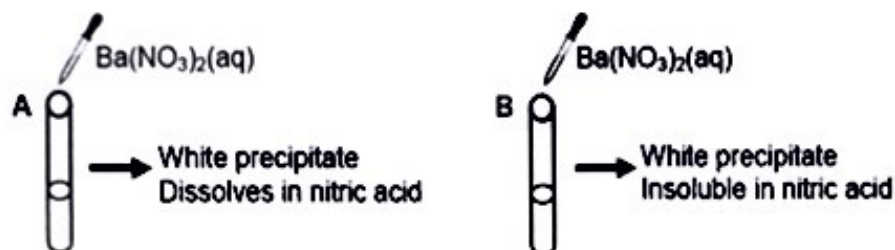
5.1.   Name the type of reaction done by adding $Ba(NO_3)_2$ (1)

5.2.   Write down the formula of Sodium salt in:

     5.2.1. Test tube A   (2)

     5.2.2. Test tube B   (2)

5.3.   Write down the name of precipitate formed in:

     5.3.1. Test tube A.   (2)

     5.3.2. Test tube B.   (2)

5.4.   White precipitate in test tube A dissolved after the addition of nitric acid.   (4)
Write down a balanced chemical equation to show this reaction.

[13]

QUESTION 6

Sodium chloride crystals are added to water and dissociate to form an electrolyte.
The experimental set up below was used to determine the electrical conductivity of
sodium chloride solution.
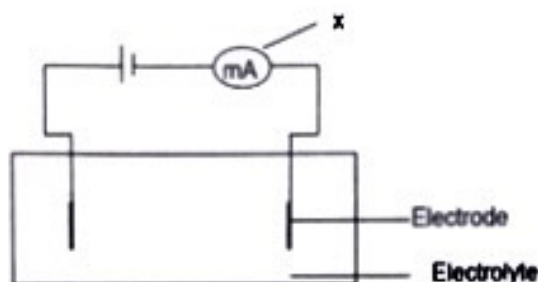
6.1	Define an **electrolyte**.	(2)
6.2.	What physical quantity is measured by component X?	(1)
6.3.	What is meant by the term **dissociation**?	(2)
6.4	Use the chemical equation to explain the answer in 6.3.	(2)
6.5.	How would the increase in concentration of the solution affect the reading on X? (Choose from: INCREASES; DECREASES or REMAINS THE SAME) Explain the answer.	(3)

[10]

QUESTION 7

Study the following diagrams and then answer the questions set.

Oxygen　　　　　　Nitrogen　　　　　　Hydrogen

7.1.　Identify the letter that represents:

7.1.1. Physical change.　　　　　　　　　　　　　　　　　　　(1)

7.1.2. Chemical change.　　　　　　　　　　　　　　　　　　(1)

7.2.　Now, consider A:

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

7.2.2. With the use of calculations, determine whether the law in 7.2.1. is　(3)
obeyed or not obeyed.

7.2.3. Name the type of bond between nitrogen and hydrogen at the final　(1)
stage.

7.3.　Use the Lewis structure to write down an equation for the formation of the　(3)
molecule in B.

[11]

QUESTION 8

8.1.   Given the data on the table below answer the questions that follows

Element	Ionization energies (kJ•mol⁻¹)		
	1ˢᵗ	2ⁿᵈ	3ʳᵈ
Potassium	419	3051	4419

8.1.1. Define the *first ionization energy*.   (2)

8.1.2. State the trend of ionization energy of potassium as it moves from   (1)
        first to third.

8.1.3. Give a reason for the trend identified in 8.1.2.   (2)

8.1.4. The first ionization energy of potassium is 419 kJ•mol⁻¹, whereas the   (2)
        first ionization energy of sodium is 496 kJ•mol⁻¹.

        Describe the difference between these two GROUP 1 elements.

8.2.   Magnesium naturally exists as isotopes, ^{24}Mg, ^{25}Mg and ^{26}Mg.

Isotope	% abundance	Atomic Mass number
^{24}Mg	78,99	23,985
^{25}Mg	10,00	24,959
^{26}Mg	11,01	25,983

8.2.1   Explain the term "isotopes".   (2)

8.2.2. Calculate the relative atomic mass of magnesium.   (4)

                                                                                    [13]

TOTAL MARKS: 100

TABLE 3: THE PERIODIC TABLE OF ELEMENTS

KEY/SLEUTEL

Electronegativity / Elektronegatiwiteit →	$1,9$
Atomic number / Atoomgetal →	29
Symbol / Simbool	Cu
Approximate relative atomic mass / Benaderde relatiewe atoommassa →	$63,5$

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

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

education

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PROVINCE OF KWAZULU-NATAL

PHYSICAL SCIENCES P2
(CHEMISTRY)

COMMON TEST

JUNE 2019

MARKING GUIDELINE

NATIONAL
SENIOR CERTIFICATE

GRADE 10

MARKS: 100

TIME   :   2 hours

N.B: This marking guideline consists of 6 pages.

SECTION A

QUESTION 1

1.1   D ✓✓   (2)

1.2   C ✓✓   (2)

1.3   A ✓✓   (2)

1.4   B ✓✓   (2)

1.5   A ✓✓   (2)

1.6   C ✓✓   (2)

1.7   C ✓✓   (2)

                                                                                                          [14]

QUESTION 2

2.1

2.1.1   Cooking oil – iron fillings ✓   (1)

2.1.2.   Si ✓   (1)

2.1.3. $CuSO_4$, Fe_2O_3 ✓ (Any one of the two)   (1)

2.1.4. Fe_2O_3 ✓   (1)

2.1.5. Cl_2 ✓   (1)

2.2.

2.2.1.   Homogeneous ✓, water-ethanol form a mixture of uniform composition and all   (2)
           components are in the same phase at room temperature ✓

2.2.2.   Fractional distillation ✓   (1)

2.2.3.   Boiling point ✓   (1)

2.2.4.   Water ✓   (1)

2.2.5.   It mixes completely in all proportions. ✓✓   (2)

                                                                                                          [12]

QUESTION 3

3.1.   Temperature is the average measure of kinetic energy of molecules. ✓✓   (2)

3.2.1.   ▪ Closely packed. ✓ (Any one property mentioned)   (1)
           ▪ Irregular shape
           ▪ Take shape of the container.

3.2.2.   ▪ Closely packed. ✓ (Any one property mentioned)   (1)
           ▪ Regular shape / Rigid shape

3.3.1.   Melting ✓   (1)

3.3.2.   Heat energy is absorbed to increase the internal (potential) energy of   (2)
           particles✓ and disturb attractive forces between particles. ✓

3.4.1.   Liquid phase ✓   (1)

3.4.2.   Solid phase✓   (1)

3.5.   LOWER THAN ✓   (1)

3.6.   Substance **Y**✓, melting point and boiling point is 0 and 100 C respectively, (2)
           which matches water. ✓

                                                                                         [12]

QUESTION 4

4.1.1.   Group 5(15) ✓, there are 5 electrons in the outermost orbitals ✓   (2)

4.1.2.   Period 3 ✓, the highest energy level is 3 ✓.   (2)

$$2 \; Al\!\!\overset{xx}{\underset{}{x}} \;\; + \; 3 \; \overset{\bullet}{\underset{\bullet\bullet}{O}}_{\bullet\bullet} \;\; \rightarrow \;\; 2 \; Al^{3+} \;\; 3 \left[x\bullet \overset{x\bullet}{\underset{\bullet\bullet}{O}}_{\bullet\bullet} \right]^{2-}$$

       Reactants ✓ Products: Ions and Electrons✓ Ratio✓   (3)

4.3.1.   Halogens ✓   (1)

4.3.2.   1 ✓   (1)

4.3.3.   7 electrons ✓   (1)

4.3.4. $Q + 1e^{-} \rightarrow Q^{-1}$ ✓✓   (2)

4.4.1.   (2)
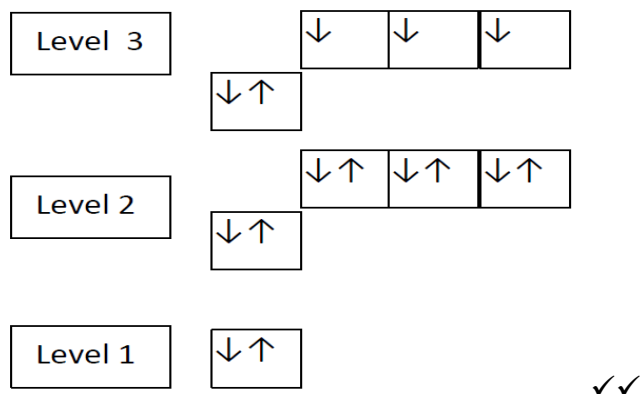
4.4.2.   Phosphorus ✓   (1)

[15]

QUESTION 5

5.1.	Precipitation reaction ✓	(1)

5.2.1.	Na_2SO_4 ✓✓	(2)
5.2.2.	Na_2CO_3 ✓✓	(2)

5.3.1.	Barium sulphate ✓✓	(2)
5.3.2.	Barium carbonate ✓✓	(2)

5.4.	$BaSO_4 (s) + 2HNO_3(aq) \rightarrow Ba(NO_3)_2(aq) + H_2SO_4 (aq)$	(4)
	Reactants ✓ Products ✓ Balance ✓	
	Correct phases ✓ -	

[13]

QUESTION 6

6.1.	An electrolyte is the ionic solution that can conduct electricity. ✓✓	(2)
6.2.	(Electric) Current. ✓	(1)
6.3.	Dissociation is the process in which ionic solids are broken up into ions when dissolved in water ✓✓	(2)
6.4.	$NaCl (s) \rightarrow Na^+(aq) + Cl^- (aq)$ ✓✓	(2)
6.5.	Increases ✓	(3)
	An increase in concentration increases the number of ions in solution ✓	
	Thus electrical conductivity increases ✓	

[10]

QUESTION 7
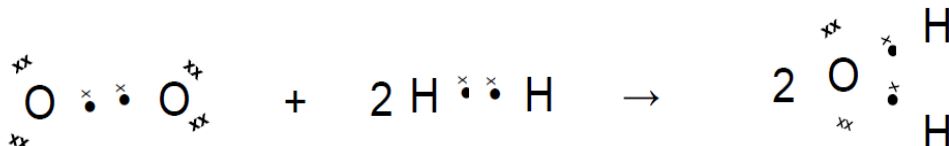
7.1.1.	B ✓	(1)
7.1.2.	A ✓	(1)

7.2.1. Matter cannot be created or destroyed, transforms from one form to   (2)
another✓✓

7.2.2. $M_{reactant} = M_{N2} + M_{H2}$ = 14x2 + 1x2x3 = 34 g.mol^{-1}✓   (3)
$M_{products} = M_{NH3}$ =14x2 + 1x2x3 = 34 g.mol^{-1}✓
(Mass of reactants is equal to the mass of products, therefore) the law is
obeyed ✓

7.2.3. Covalent bond ✓   (1)

7.3.   (3)

Reactants ✓ Products ✓ balance ✓

[11]

QUESTION 8

8.1.1. Energy needed per mole to remove an electron from an atom in a gaseous   (2)
phase. ✓✓
8.1.2. Increases ✓   (1)
8.1.3. As one moves from 1st to 3rd ionization energy   (2)
Electrons occupy the lower energy levels which increases the effective force of
attraction between nucleus and electrons, thus more energy is required to
remove electrons✓✓
8.1.4. As one moves down the group ✓,First ionization energy decreases✓   (2)
Or
As one moves up the group ✓,First ionization energy increases✓

8.2.1.   Isotopes are atoms of the same element having the same number of protons, but   (2)
different numbers of neutrons.

8.2.2.   (4)

$$\text{R.A.M} = \frac{M^{24}_{Mg} \times \% \text{ abundance}}{100\%} + \frac{M^{25}_{Mg} \times \% \text{ abundance}}{100\%} \quad \frac{M^{26}_{Mg} \times \% \text{ abundance}}{100\%}$$

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

$$= 24{,}30 \text{ g.mol}^{-1} \checkmark$$

[13]

TOTAL MARKS: **[100]**