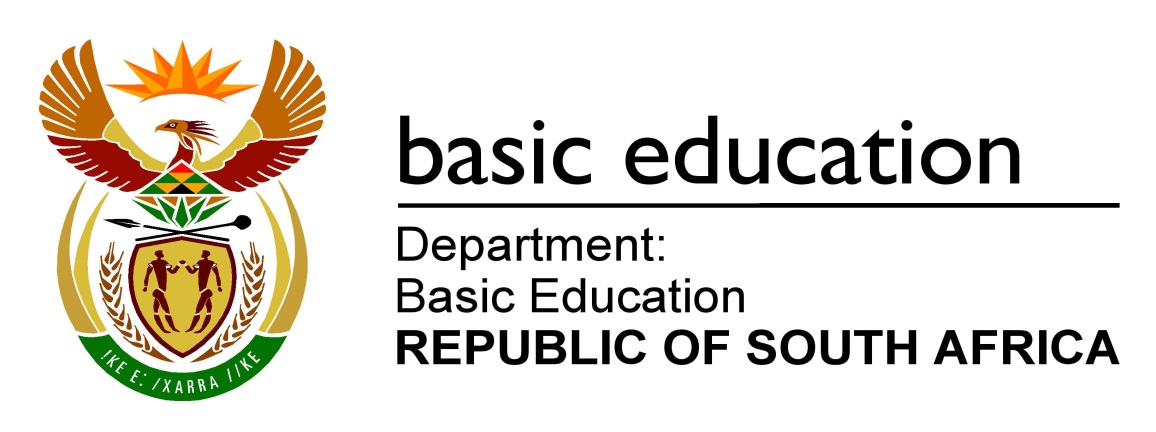
# TECHNICAL SCIENCES P2

# EXEMPLAR 2018

# NATIONAL

# SENIOR CERTIFICATE



# GRADE 12

**MARKS: 150**

# TIME: 3 hours

**This question paper consists of 16 pages and 4 data sheets.**

**INSTRUCTIONS AND INFORMATION**

|  |  |  |  |
| --- | --- | --- | --- |
| 2.  3.  4.  5.  6.  7.  8.  9. | This question paper consists of NINE questions. Answer ALL the questions in the ANSWER BOOK.  Start EACH question on a NEW page in the ANSWER BOOK.  Number the answers correctly according to the numbering system used in this question paper.  Leave ONE line between two subquestions, e.g. between QUESTION 2.1 and QUESTION 2.2.  You may use a non-programmable calculator.  You are advised to use the attached DATA SHEETS.  Round off your FINAL numerical answers to a minimum of TWO decimal places.  Give brief motivations, discussions etc. where required.  Write neatly and legibly. |  |  |

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| QUESTION 1: MULTIPLE-CHOICE QUESTIONS |  |  |

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| Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question number (1.1–1.10) in the ANSWER BOOK, e.g. 1.11 D. |  |  |

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| 1.1 | Which ONE of the following is a general formula of alkenes? |  |  |

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|  | A  B  C  D | CnH2n  CnH2n+2  C2H2n  C2nHn |  | (2) |

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| 1.2 | Which ONE of the IUPAC names below is CORRECT for the given structure? |  |  |

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|  | A  B  C  D | 3-chloro-4-methylpentane  3-chloro-2-methylpentane  2-methyl-3-chloropentane  4-methyl-3-chloropentane |  | (2) |

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| 1.3 | The melting points of four different straight chain hydrocarbons are given in the table below. |  |  |

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|  | |  |  | | --- | --- | | **HYDROCARBON** | **MELTING POINT (°C)** | | (i) | −182,5 | | (ii) | −95 | | (iii) | 28 | | (iv) | −56,5 | |  |  |
|  |  |  |  |
|  | The hydrocarbon with the strongest intermolecular force is … |  |  |

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|  | A  B  C  D | (i)  (ii)  (iii)  (iv) |  | (2) |

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| 1.4 | Identify the reaction that can be used to prepare ETHANE from ETHENE: |  |  |

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|  | A  B  C  D | Substitution  Halogenation  Hydrogenation  Dehydrogenation |  | (2) |

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| 1.5 | A learner left a solution of copper sulphate in a zinc container overnight. The next morning a brown insoluble substance coated the sides and bottom of the zinc container. The container was corroded and some of the solution had leaked to the floor.  Which ONE of the following reactions took place inside the zinc container? |  |  |

|  |  |  |  |  |
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|  | A  B  C  D | Cu(s) + ZnSO4(aq) → CuSO4(aq) + Zn(s)  Cu2+(aq) + ZnSO4(aq) → CuSO4(aq) + Zn(s)  Zn2+(aq) + CuSO4(aq) → ZnSO4(aq) + Cu2+(aq)  Zn(s) + CuSO4(aq) → ZnSO4(aq) + Cu(s) |  | (2) |

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| 1.6 | In an electrochemical cell, what relationship must be TRUE about the values of Eөoxidising agent and Eөreducing agent for the reaction to occur spontaneously under standard conditions? |  |  |

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|  | A  B  C  D | Eөreducing agent > 0 and Eөoxidising agent > 0  Eөreducing agent < 0 and Eөoxidising agent  < 0  Eөreducing agent > Eөoxidising agent  Eөreducing agent < 0 and Eөoxidising agent > 0 |  | (2) |

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| 1.7 | The phenomenon by which light falling on a surface is sent back into the same medium is known as ... |  |  |

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|  | A  B  C  D | reflection.  refraction.  diffraction.  dispersion. |  | (2) |

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| 1.8 | An object is placed 1,5 m in front of the mirror. What will be the image distance? |  |  |

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|  | A  B  C  D | 0,75 m  1,5 m  2 m  3 m |  | (2) |

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| 1.9 | If the object is placed between the focal point and the convex lens, the image formed is … |  |  |

|  |  |  |  |  |
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|  | A  B  C  D | smaller, upright and real.  smaller, inverted and real.  enlarged, inverted and virtual.  enlarged, upright and virtual. |  | (2) |

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| --- | --- | --- | --- |
| 1.10 | When a ray of light moves from a less dense optical medium to a more dense optical medium, the speed of light will … |  |  |

|  |  |  |  |  |
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|  | A  B  C  D | increase.  decrease.  remain the same.  increase and then decrease. |  | (2)  **[20]** |

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| **QUESTION 2 (Start on a new page.)** |  |  |

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| Consider the representation of organic molecules **A** to **F** below. |  |  |

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|  | |  |  |  |  | | --- | --- | --- | --- | | **A** |  | **B** |  | | **C** |  | **D** | Methanal | | **E** | 2-methylhex-3-yne | **F** |  | |  |  |

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| 2.1 | Define a *homologous series*. |  | (2) |

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| 2.2 | Write down the NAME of the homologous series to which EACH of the following compounds belong: |  |  |

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|  | 2.2.1 | A |  | (1) |

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|  | 2.2.2 | B |  | (1) |

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|  | 2.2.3 | C |  | (1) |

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|  | 2.2.4 | F |  | (1) |

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| 2.3 | Write down the letter that represents a compound that: |  |  |

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|  | 2.3.1 | Is an aldehyde |  | (1) |

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| --- | --- | --- | --- | --- |
|  | 2.3.2 | Is a saturated hydrocarbon |  | (1) |

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|  | 2.3.3 | Has a general formula CnH2n-2 |  | (1) |

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| 2.4 | Write down the: |  |  |

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|  | 2.4.1 | Molecular formula of the next compound in the same homologous series as compound **C** |  | (2) |

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|  | 2.4.2 | Structural formula of compound **E** |  | (3) |

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|  | 2.4.3 | IUPAC name of compound **B** |  | (3) |

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|  | 2.4.4 | Structural formula of the functional group of compound **D** |  | (2)  **[19]** |

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| **QUESTION 3 (Start on a new page.)** |  |  |

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| 3.1 | Polymers are macro-organic molecules that occur in nature, e.g. rubber found in a rubber tree. Some synthetic polymers are referred to as plastic, e.g. plastic bags, PVC gutters, etc. |  |  |

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|  | 3.1.1 | Define a *polymer*. |  | (2) |

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|  | 3.1.2 | Name ONE use of polythene. |  | (1) |

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| 3.2 | Consider the table below and answer the questions that follow.   |  |  |  | | --- | --- | --- | | **COMPOUND** | **MOLAR MASS**  **(g·mol-1)** | **VAPOUR PRESSURE**  **(x 102 Pa)** | | Pentane | 72 | 573,0 | | Hexane | 86 | 160,0 | | Heptane | 100 | 48,0 | | Propan-1-ol | 60 | 21,0 | | Butan-1-ol | 74 | 6,2 | | Pentan-1-ol | 88 | 2,2 | | Ethanoic acid | 60 | 15,3 | |  |  |

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|  | 3.2.1 | Name the intermolecular forces in alkanes and in alcohols. |  | (3) |

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|  | 3.2.2 | Explain the difference in vapour pressure between the three alkanes in the table above. |  | (3) |

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|  | 3.2.3 | Which ONE, ethanoic acid OR propan-1-ol, has the higher boiling point? |  | (1) |

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|  | 3.2.4 | Explain the answer to QUESTION 3.2.3. |  | (3)  **[13]** |

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| **QUESTION 4 (Start on a new page.)** |  |  |

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| Fossil fuels are formed by the natural process of decomposition of organisms under heat and pressure. They contain a high percentage of carbon and include fuels such as coal, petrol and natural gases. Alkanes are the most important fossil fuel. The combustion of alkanes (also known as oxidation) is highly exothermic. |  |  |

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| 4.1 | Write a balanced equation to show the complete combustion reaction of propane. |  | (3) |

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| 4.2 | Prop-1-ene can be converted to other compounds by means of different organic reactions represented by **P**, **R**, **S** and **T**, as shown below. |  |  |

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|  | Alcohol  **P**  Prop-1-ene  **R**  **T**  **S**  Alkane  Haloalkane  Cℓ 2 |  |  |

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|  | Write down the TYPE of the reaction represented by: |  |  |

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|  | 4.2.1 | **P** |  | (2) |

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|  | 4.2.2 | **S** |  | (2) |

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|  | 4.2.3 | **R** |  | (2) |

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|  | During reaction **T**, the alkyl halide (haloalkane) reacts in the presence of a base to form an alcohol. |  |  |

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|  | 4.2.4 | Give the NAME of a suitable base used. |  | (1) |

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|  | 4.2.5 | Name TWO reaction conditions required. |  | (2)  **[12]** |

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| **QUESTION 5 (Start on a new page.)** |  |  |
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| The owner of a building complained about the underground water pipes that leak.  The plumber dug up the underground water pipes and discovered that they were made of iron and had several holes. To minimise costs only the parts of the pipe with holes were replaced. After fixing the leak, the plumber attached a zinc bar to the buried iron water pipe and made sure that the zinc made contact with the iron pipe. |  |  |

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| 5.1 | What is the purpose of attaching the zinc bar to the iron pipe? |  | (1) |

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| 5.2 | Use the Table of Standard Reduction Potentials to explain the answer to QUESTION 5.1. |  | (2) |

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| 5.3 | Use the information extracted from the Table of Standard Reduction Potentials for a number of half-reactions to answer the questions that follow.   |  |  | | --- | --- | | **Half-reactions** | **E0 (volt)** | | Zn2+ + 2e-⇌Zn | –0,76 | | Fe2+ + 2e-⇌Fe | –0,44 | | I2 + 2e- ⇌ 2I - | +0,54 | | Fe3+ + e- ⇌ Fe2+ | +0,77 | | Ce4+ + e- ⇌Ce3+ | +1,61 | |  |  |

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|  | 5.3.1 | Identify the substance that can be reduced easily. |  | (1) |

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|  | 5.3.2 | In an electrolytic cell, would the substance in QUESTION 5.3.1 be the ANODE or the CATHODE? |  | (1) |

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|  | 5.3.3 | Motivate the answer to QUESTION 5.3.2. |  | (2) |

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|  | 5.3.4 | Write a balanced ionic equation for the reaction between iodine and iron (III) ions (Fe3+). |  | (3) |

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| 5.4 | Copper metal is used extensively in industry. Impure copper produced by mining can be purified by electrolysis, as shown in the diagram below. |  |  |

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| Impure copper  Electrolyte  Pure copper | PSC1280 |  |  |

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|  | 5.4.1 | Define an *electrolytic cell*. |  | (2) |

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|  | 5.4.2 | Which electrode will act as the anode? (Write only PURE COPPER or IMPURE COPPER.) |  | (1) |

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|  | 5.4.3 | Which reaction occurs at the anode? |  | (1) |

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|  | 5.4.4 | Write down the half-reaction that occurs at the cathode. |  | (2) |

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|  | 5.4.5 | Which solution can be used as an electrolyte? |  | (1) |
|  |  |  |  | **[17]** |

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| **QUESTION 6 (Start on a new page.)** |

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| 6.1 | A learner constructed an electrochemical cell using copper and zinc electrodes. The cell was set up as illustrated below. |  |  |

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|  | V  Salt bridge      Cu electrozde  Zn electrode            Cu2+ (zzzaq)  Zn2+ (aq) |  |  |

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|  | 6.1.1 | Identify the type of electrochemical cell shown in the diagram above. |  | (1) |

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|  | 6.1.2 | Which energy conversion occurs in this cell? |  | (2) |

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|  | 6.1.3 | Write down TWO functions of the salt bridge. |  | (2) |

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|  | 6.1.4 | What is the direction of electron flow? |  | (2) |
|  |  |  |  |  |
|  | 6.1.5 | Why is KNO3 the preferred electrolyte to be used in the salt bridge instead of BaCl2? |  | (2) |

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| 6.2 | For this cell: |  |  |

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|  | 6.2.1 | Write down the net reaction. |  | (2) |

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|  | 6.2.2 | Give the standard conditions. |  | (2) |

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|  | 6.2.3 | Write down the cell notation. |  | (3) |

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| 6.3 | **HYDROGEN-FUELLED CAR**  The hydrogen car, developed in Norway, uses electric current and hydrogen gas instead of fossil fuels. The maintenance free batteries give the car  a range of 125 km, which covers daily driving needs easily. The batteries can be charged using a plug or a hydrogen fuel cell while driving. The hydrogen tank doubles the driving range to 250 km and can be refilled in a few minutes. Finally, a zero-emissions vehicle is available.  [Source: <http://www.pivco.no/content.php?id=40>] |  |  |

|  |  |  |  |
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|  | Individual fuel cell used in hydrogen-fuelled car  Hydrogen-fuelled car |  |  |

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| --- | --- | --- | --- | --- |
|  | 6.3.1 | Give TWO emissions that ordinary petrol-powered cars would produce? |  | (2) |

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| 6.3.2 | Give ONE: |  |  |

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| --- | --- | --- | --- | --- |
|  | (a) | Advantage of a hydrogen-fuelled car |  | (1) |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | (b) | Disadvantage of a hydrogen-fuelled car |  | (1) |
|  |  |  |  | **[20]** |

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| **QUESTION 7 (Start on a new page.)** |  |  |

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| Use the ray diagram below to answer the questions. |  |  |

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|  | Object  20°  **B**  **A**  **C**  Image  1  2 |  |  |

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| 7.1 | Write down the NAME of the phenomenon illustrated in the diagram above. |  | (1) |

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| 7.2 | Give the reason why the light ray did not penetrate the surface of the medium. |  | (2) |

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| 7.3 | State TWO requirements for the phenomenon in the diagram above. |  | (2) |

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| 7.4 | Give suitable NAMES for lines **A**, **B** and **C**. |  | (3) |

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| 7.5 | Write down the NAME and the MAGNITUDE of the following: |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 7.5.1 | Angle 1 |  | (2) |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 7.5.2 | Angle 2 |  | (2) |

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| 7.6 | When white light falls onto a triangular prism, a spectrum of seven colours is visible. |  |  |

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|  | 7.6.1 | What do we call this phenomenon? |  | (1) |

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|  | 7.6.2 | Which colour of light is refracted the most? |  | (1) |

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|  | 7.6.3 | Explain the answer to QUESTION 7.6.2 in terms of the wavelength. |  | (2)  **[16]** |

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| **QUESTION 8 (Start on a new page.)** |  |  |

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| One of the most practical applications of total internal reflection is in fibre optics. Study the diagrams below and answer the questions that follow. | |  |  |
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| 8.1 | Define *refraction*. |  | (2) |

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| 8.2 | Identify the phenomenon taking place in Diagram 3. |  | (1) |

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| 8.3 | The surfaces in the diagrams above have different optical densities. |  |  |

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|  | 8.3.1 | Which surface is optically denser: surface **A** or surface **B**? |  | (1) |

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|  | 8.3.2 | Explain the answer to QUESTION 8.3.1. |  | (2) |

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| 8.4 | 8.4.1 | In which diagram, **1**, **2** or **3**, is the incidence angle called the critical angle? |  | (1) |

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|  | 8.4.2 | Justify the answer to QUESTION 8.4.1. |  | (2) |

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| 8.5 | Name TWO: |  |  |

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|  | 8.5.1 | Conditions for total internal reflection |  | (2) |

|  |  |  |  |  |
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|  | 8.5.2 | Applications of total internal reflection |  | (2) |

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| 8.6 | Short-sighted people cannot see faraway objects because their eyeballs are too long. This results in light from distant objects falling in front of the retina, thus making the image blurred. To correct this defect, optometrists prescribe lenses that enable patients to see distant objects.  Use a labelled diagram to illustrate how such a lens will correct short-sightedness. |  | (5)  **[18]** |

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| **QUESTION 9 (Start on a new page.)** |  |  |

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| Electromagnetic waves have a wave anda particle nature and they can be transmitted through empty space. |  |

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| 9.1 | Define an *electromagnetic wave*. |  | (2) |

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 9.2 | The diagram below represents radiations of the electromagnetic spectrum.   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | Infrared | Radio waves | X-rays | Microwaves | Gamma rays | Ultraviolet rays | Visible light | | |  |  |
|  | 9.2.1 | Arrange the spectrum in order of increasing frequency. |  | (2) |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 9.2.2 | In which radiation will a photon have the highest energy? |  | (1) |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 9.2.3 | Explain the answer to QUESTION 9.2.2. |  | (2) |

|  |  |  |  |
| --- | --- | --- | --- |
| 9.3 | Calculate the energy of a photon of an electromagnetic wave with a wavelength of 470 nm. |  | (5) |

|  |  |  |  |
| --- | --- | --- | --- |
| 9.4 | How will the energy of a photon with a wavelength of 490 nm compare with that calculated in QUESTION 9.3? (Write only GREATER THAN, SMALLER THAN or EQUAL TO). |  | (1) |

|  |  |  |  |
| --- | --- | --- | --- |
| 9.5 | Identify the electromagnetic radiation best suitable for use in the following: |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 9.5.1 | Security scanners |  | (1) |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 9.5.2 | Sterilisation of food and appliances |  | (1) | |
|  |  | |  | | **[15]** |

|  |  |  |  |
| --- | --- | --- | --- |
|  | **TOTAL:** |  | **150** |

**DATA FOR TECHNICAL SCIENCES GRADE 12**

**PAPER 2**

***GEGEWENS VIR TEGNIESE WETENSKAPPE GRAAD 12***

***VRAESTEL 2***

**TABLE 1/*TABEL 1***

|  |  |  |
| --- | --- | --- |
| **PHYSICAL CONSTANTS*/FISIESE KONSTANTES*** | | |
| **CONSTANT/*KONSTANTE*** | **SYMBOL/*SIMBOOL*** | **VALUE/*WAARDE*** |
| Planck's constant  *Planck se konstante* | h |  |
| Speed of light  *Spoed van lig* | c |  |

**TABLE 2/*TABEL 2***

|  |  |
| --- | --- |
| **WAVES, SOUND AND LIGHT/*GOLWE, KLANK EN LIG*** | |
| Speed/*Spoed* | c = *f* λ |
| Energy/*Energie* | E = h*f*  or/*of* |

**TABLE 3/*TABEL 3***

|  |  |
| --- | --- |
| **ELECTROCHEMISTRY/*ELEKTROCHEMIE*** | |
| Emf/*Emk* | /  or/*of*  /  or/*of*  / |

**TABLE 4A: STANDARD REDUCTION POTENTIALS**

***TABEL 4A: STANDAARD-REDUKSIEPOTENSIALE***

|  |  |  |  |
| --- | --- | --- | --- |
| **Half-reactions/*Halfreaksies*** | | | **(V)** |
| F2(g) + 2e− | ⇌ | 2F− | + 2,87 |
| Co3+ + e− | ⇌ | Co2+ | + 1,81 |
| H2O2 + 2H+ +2e− | ⇌ | 2H2O | +1,77 |
| MnO + 8H+ + 5e− | ⇌ | Mn2+ + 4H2O | + 1,51 |
| Cℓ2(g) + 2e− | ⇌ | 2Cℓ− | + 1,36 |
| Cr2O + 14H+ + 6e− | ⇌ | 2Cr3+ + 7H2O | + 1,33 |
| O2(g) + 4H+ + 4e− | ⇌ | 2H2O | + 1,23 |
| MnO2+ 4H+ + 2e− | ⇌ | Mn2+ + 2H2O | + 1,23 |
| Pt2+ + 2e−  **Increasing oxidising ability/*Toenemende oksiderende vermoë*** | ⇌ | Pt | + 1,20  **Increasing reducing ability/*Toenemende reduserende vermoë*** |
| Br2(ℓ) + 2e− | ⇌ | 2Br− | + 1,07 |
| NO + 4H+ + 3e− | ⇌ | NO(g) + 2H2O | + 0,96 |
| Hg2+ + 2e− | ⇌ | Hg(ℓ) | + 0,85 |
| Ag+ + e− | ⇌ | Ag | + 0,80 |
| NO + 2H+ + e− | ⇌ | NO2(g) + H2O | + 0,80 |
| Fe3+ + e− | ⇌ | Fe2+ | + 0,77 |
| O2(g) + 2H+ + 2e− | ⇌ | H2O2 | + 0,68 |
| I2 + 2e− | ⇌ | 2I− | + 0,54 |
| Cu+ + e− | ⇌ | Cu | + 0,52 |
| SO2 + 4H+ + 4e− | ⇌ | S + 2H2O | + 0,45 |
| 2H2O + O2 + 4e− | ⇌ | 4OH− | + 0,40 |
| Cu2+ + 2e− | ⇌ | Cu | + 0,34 |
| SO + 4H+ + 2e− | ⇌ | SO2(g) + 2H2O | + 0,17 |
| Cu2+ + e− | ⇌ | Cu+ | + 0,16 |
| Sn4+ + 2e− | ⇌ | Sn2+ | + 0,15 |
| S + 2H+ + 2e− | ⇌ | H2S(g) | + 0,14 |
| **2H+ + 2e−** | **⇌** | **H2(g)** | **0,00** |
| Fe3+ + 3e− | ⇌ | Fe | − 0,06 |
| Pb2+ + 2e− | ⇌ | Pb | − 0,13 |
| Sn2+ + 2e− | ⇌ | Sn | − 0,14 |
| Ni2+ + 2e− | ⇌ | Ni | − 0,27 |
| Co2+ + 2e− | ⇌ | Co | − 0,28 |
| Cd2+ + 2e− | ⇌ | Cd | − 0,40 |
| Cr3+ + e− | ⇌ | Cr2+ | − 0,41 |
| Fe2+ + 2e− | ⇌ | Fe | − 0,44 |
| Cr3+ + 3e− | ⇌ | Cr | − 0,74 |
| Zn2+ + 2e− | ⇌ | Zn | − 0,76 |
| 2H2O + 2e− | ⇌ | H2(g) + 2OH− | − 0,83 |
| Cr2+ + 2e− | ⇌ | Cr | − 0,91 |
| Mn2+ + 2e− | ⇌ | Mn | − 1,18 |
| Aℓ3+ + 3e− | ⇌ | Aℓ | − 1,66 |
| Mg2+ + 2e− | ⇌ | Mg | − 2,36 |
| Na+ + e− | ⇌ | Na | − 2,71 |
| Ca2+ + 2e− | ⇌ | Ca | − 2,87 |
| Sr2+ + 2e− | ⇌ | Sr | − 2,89 |
| Ba2+ + 2e− | ⇌ | Ba | − 2,90 |
| Cs+ + e- | ⇌ | Cs | - 2,92 |
| K+ + e− | ⇌ | K | − 2,93 |
| Li+ + e− | ⇌ | Li | − 3,05 |

**TABLE 4B: STANDARD REDUCTION POTENTIALS**

***TABEL 4B: STANDAARD-REDUKSIEPOTENSIALE***

|  |  |  |  |
| --- | --- | --- | --- |
| **Half-reactions/*Halfreaksies*** | | | **(V)** |
| Li+ + e− | ⇌ | Li | − 3,05 |
| K+ + e− | ⇌ | K | − 2,93 |
| Cs+ + e− | ⇌ | Cs | − 2,92 |
| Ba2+ + 2e− | ⇌ | Ba | − 2,90 |
| Sr2+ + 2e− | ⇌ | Sr | − 2,89 |
| Ca2+ + 2e− | ⇌ | Ca | − 2,87 |
| Na+ + e− | ⇌ | Na | − 2,71 |
| Mg2+ + 2e− | ⇌ | Mg | − 2,36 |
| Aℓ3+ + 3e− | ⇌ | Aℓ | − 1,66 |
| Mn2+ + 2e− | ⇌ | Mn | − 1,18 |
| Cr2+ + 2e− | ⇌ | Cr | − 0,91 |
| 2H2O + 2e− | ⇌ | H2(g) + 2OH− | − 0,83 |
| Zn2+ + 2e− | ⇌ | Zn | − 0,76 |
| Cr3+ + 3e− | ⇌ | Cr | − 0,74 |
| Fe2+ + 2e− | ⇌ | Fe | − 0,44 |
| Cr3+ + e− | ⇌ | Cr2+ | − 0,41 |
| Cd2+ + 2e− | ⇌ | Cd | − 0,40 |
| Co2+ + 2e− | ⇌ | Co | − 0,28 |
| Ni2+ + 2e− | ⇌ | Ni | − 0,27 |
| Sn2+ + 2e− | ⇌ | Sn | − 0,14 |
| Pb2+ + 2e− | ⇌ | Pb | − 0,13 |
| Fe3+ + 3e− | ⇌ | Fe | − 0,06 |
| **2H+ + 2e−** | **⇌** | **H2(g)** | **0,00** |
| S + 2H+ + 2e− | ⇌ | H2S(g) | + 0,14 |
| Sn4+ + 2e− | ⇌ | Sn2+ | + 0,15 |
| Cu2+ + e− | ⇌ | Cu+ | + 0,16 |
| SO + 4H+ + 2e− | ⇌ | SO2(g) + 2H2O | + 0,17 |
| Cu2+ + 2e− | ⇌ | Cu | + 0,34 |
| 2H2O + O2 + 4e− | ⇌ | 4OH− | + 0,40 |
| SO2 + 4H+ + 4e− | ⇌ | S + 2H2O | + 0,45 |
| Cu+ + e− | ⇌ | Cu | + 0,52 |
| I2 + 2e− | ⇌ | 2I− | + 0,54 |
| O2(g) + 2H+ + 2e− | ⇌ | H2O2 | + 0,68 |
| Fe3+ + e− | ⇌ | Fe2+ | + 0,77 |
| NO + 2H+ + e− | ⇌ | NO2(g) + H2O | + 0,80 |
| Ag+ + e− | ⇌ | Ag | + 0,80 |
| Hg2+ + 2e− | ⇌ | Hg(ℓ) | + 0,85 |
| NO + 4H+ + 3e− | ⇌ | NO(g) + 2H2O | + 0,96 |
| Br2(ℓ) + 2e− | ⇌ | 2Br− | + 1,07 |
| Pt2+ + 2 e− | ⇌ | Pt | + 1,20 |
| MnO2+ 4H+ + 2e− | ⇌ | Mn2+ + 2H2O | + 1,23 |
| O2(g) + 4H+ + 4e− | ⇌ | 2H2O | + 1,23 |
| Cr2O + 14H+ + 6e− | ⇌ | 2Cr3+ + 7H2O | + 1,33 |
| Cℓ2(g) + 2e− | ⇌ | 2Cℓ− | + 1,36 |
| MnO + 8H+ + 5e− | ⇌ | Mn2+ + 4H2O | + 1,51 |
| H2O2 + 2H+ +2 e− | ⇌ | 2H2O | +1,77 |
| Co3+ + e− | ⇌ | Co2+ | + 1,81 |
| F2(g) + 2e− | ⇌ | 2F− | + 2,87 |

**Increasing oxidising ability/*Toenemende oksiderende vermoë***

**Increasing reducing ability/*Toenemende reduserende vermoë***

# TABLE 5: THE PERIODIC TABLE OF ELEMENTS/*TABEL 5: DIE PERIODIEKE TABEL VAN ELEMENTE*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **1**  **(I)** | | **2**  **(II)** | | **3** | | **4**  **Approximate relative atomic mass**  ***Benaderde relatiewe atoommassa***  **Atomic number**  ***Atoomgetal***  **29**  **Cu**  **63,5**  **1,9**  **Symbol**  ***Simbool***  **Electronegativity**  ***Elektronegatiwiteit***  **KEY/*SLEUTEL*** | | **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** | |