# TEGNIESE WETENSKAPPE V2

# MODEL 2018

# NASIONALE

# SENIOR SERTIFIKAAT



# GRAAD 12

**PUNTE: 150**

# TYD: 3 uur

**Hierdie vraestel bestaan uit 16 bladsye en 4 gegewensblaaie.**

**INSTRUKSIES EN INLIGTING**

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| 2.  3.  4.  5.  6.  7.  8.  9. | Hierdie vraestel bestaan uit NEGE vrae. Beantwoord AL die vrae in die ANTWOORDEBOEK.  Begin ELKE vraag op 'n NUWE bladsy in die ANTWOORDEBOEK.  Nommer die antwoorde korrek volgens die nommeringstelsel wat in hierdie vraestel gebruik is.  Laat EEN reël oop tussen twee subvrae, bv. tussen VRAAG 2.1 en  VRAAG 2.2.  Jy mag 'n nieprogrammeerbare sakrekenaar gebruik.  Jy word aangeraai om die aangehegte GEGEWENSBLAAIE te gebruik.  Rond jou FINALE numeriese antwoorde tot 'n minimum van TWEE desimale plekke af.  Gee kort (bondige) motiverings, besprekings, ens. waar nodig.  Skryf netjies en leesbaar |  |  |

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| VRAAG 1: MEERVOUDIGEKEUSE-VRAE |  |  |

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| Verskeie opsies word as moontlike antwoorde op die volgende vrae gegee. Kies die antwoord en skryf slegs die letter (A–D) langs die vraagnommer (1.1–1.10) in die ANTWOORDEBOEK neer, bv. 1.11 D. |  |  |

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| 1.1 | Watter EEN van die volgende is 'n algemene formule van alkene? |  |  |

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

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| 1.2 | Watter EEN van die IUPAC-name hieronder is KORREK vir die gegewe struktuur? |  |  |
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|  | A  B  C  D | 3-chloro-4-metielpentaan  3-chloro-2-metielpentaan  2-metiel-3-chloropentaan  4-metiel-3-chloropentaan |  | (2) |

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| 1.3 | Die smeltpunte van vier verskillende reguitketting-koolwaterstowwe word in die tabel hieronder gegee. |  |  |
|  | |  |  | | --- | --- | | **KOOLWATERSTOF** | **SMELTPUNT (°C)** | | (i) | −182,5 | | (ii) | −95 | | (iii) | 28 | | (iv) | −56,5 | |  |  |

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|  | Die koolwaterstof met die sterkste intermolekulêre krag is … |  |  |

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

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| 1.4 | Identifiseer die reaksie wat gebruik kan word om ETAAN uit ETEEN te berei: |  |  |

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|  | A  B  C  D | Substitusie  Halogenering  Hidrogenering  Dehidrogenering |  | (2) |

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| 1.5 | 'n Leerder het oornag 'n oplossing van kopersulfaat in 'n sinkhouer gelos. 'n Bruin onoplosbare stof het die volgende oggend die kante en bodem van die sinkhouer bedek. Die houer was weggevreet en van die oplossing het op die vloer gelek.  Watter EEN van die volgende reaksies het in die sinkhouer plaasgevind? |  |  |

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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 | Watter verwantskap tussen die waardes van Eөoksideermiddel en Eөreduseermiddel in 'n elektrochemiese sel moet WAAR wees vir die reaksie om spontaan onder standaardtoestande plaas te vind? |  |  |

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|  | A  B  C  D | Eөreduseermiddel > 0 en Eөoksideermiddel > 0  Eөreduseermiddel < 0 en Eөoksideermiddel  < 0  Eөreduseermiddel > Eөoksideermiddel  Eөreduseermiddel < 0 en Eөoksideermiddel > 0 |  | (2) |

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| 1.7 | Die verskynsel waar lig wat op 'n oppervlak val, na dieselfde medium teruggekaats word, staan as … bekend. |  |  |

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|  | A  B  C  D | refleksie  refraksie  difraksie  dispersie |  | (2) |

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| 1.8 | 'n Voorwerp word 1,5 m voor 'n spieël geplaas. Wat sal die beeldafstand wees? |  |  |

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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 | Wanneer die voorwerp tussen die fokuspunt en die konvekse lens geplaas word, is die beeld wat gevorm word … |  |  |

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|  | A  B  C  D | kleiner, regop en werklik.  kleiner, omgekeerd en werklik.  vergroot, omgekeerd en skyn.  vergroot, regop en skyn. |  | (2) |

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| 1.10 | Wanneer 'n ligstraal van 'n opties minder digte medium na 'n opties meer digte medium beweeg, sal die spoed van lig … |  |  |

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|  | A  B  C  D | toeneem.  afneem.  dieselfde bly.  toeneem en dan afneem. |  | (2)  **[20]** |

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| **VRAAG 2 (Begin op 'n nuwe bladsy.)** |  | |  |
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| Beskou die voorstelling van organiese molekule **A** tot **F** hieronder. |  |  | |

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|  | |  |  |  |  | | --- | --- | --- | --- | | **A** |  | **B** |  | | **C** |  | **D** | Metanaal | | **E** | 2-metielheks-3-yn | **F** |  | |  |  |

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| 2.1 | Definieer 'n *homoloë reeks*. |  | (2) |

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| 2.2 | Skryf die NAAM van die homoloë reeks neer waaraan ELK van die volgende verbindings behoort: |  |  |

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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) |
|  |  |  |  |  |
|  | 2.2.4 | F |  | (1) |

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| 2.3 | Skryf die letter neer wat 'n verbinding verteenwoordig wat: |  |  |

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|  | 2.3.1 | 'n Aldehied is |  | (1) |

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|  | 2.3.2 | 'n Versadigde koolwaterstof is |  | (1) |

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|  | 2.3.3 | 'n Algemene formule CnH2n-2 het |  | (1) |

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| 2.4 | Skryf neer die: |  |  |

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|  | 2.4.1 | Molekulêre formule van die volgende verbinding in dieselfde homoloë reeks as verbinding **C** |  | (2) |

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|  | 2.4.2 | Struktuurformule van verbinding **E** |  | (3) |

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|  | 2.4.3 | IUPAC-naam van verbinding **B** |  | (3) |

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|  | 2.4.4 | Struktuurformule van die funksionele groep van verbinding **D** |  | (2)  **[19]** |

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| **VRAAG 3 (Begin op 'n nuwe bladsy.)** |  |  |

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| 3.1 | Polimere is makro-organiese molekule wat in die natuur voorkom, bv. rubber wat in 'n rubberboom gevind word. Daar word na sommige sintetiese polimere verwys as plastiek, bv. plastieksakkies, PVC-geute, ens. |  |  |

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|  | 3.1.1 | Definieer 'n *polimeer*. |  | (2) |

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|  | 3.1.2 | Noem EEN gebruik van politeen. |  | (1) |

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| 3.2 | Beskou die tabel hieronder en beantwoord die vrae wat volg.   |  |  |  | | --- | --- | --- | | **VERBINDING** | **MOLÊRE MASSA**  **(g·mol-1)** | **DAMPDRUK**  **(x 102 Pa)** | | Pentaan | 72 | 573,0 | | Heksaan | 86 | 160,0 | | Heptaan | 100 | 48,0 | | Propan-1-ol | 60 | 21,0 | | Butan-1-ol | 74 | 6,2 | | Pentan-1-ol | 88 | 2,2 | | Etanoësuur | 60 | 15,3 | |  |  |

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|  | 3.2.1 | Noem die intermolekulêre kragte in alkane en in alkohole. |  | (3) |

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|  | 3.2.2 | Verduidelik die verskil in dampdruk tussen die drie alkane in die tabel hierbo. |  | (3) |

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|  | 3.2.3 | Watter EEN, etanoësuur OF propan-1-ol, het die hoogste kookpunt? |  | (1) |

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|  | 3.2.4 | Verduidelik die antwoord op VRAAG 3.2.3. |  | (3)  **[13]** |

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| **VRAAG 4 (Begin op 'n nuwe bladsy.)** |  |  |

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| Fossielbrandstowwe word deur die natuurlike proses van ontbinding van organismes onder temperatuur en druk gevorm. Hulle bevat 'n hoë persentasie koolstof en sluit brandstowwe soos steenkool, petrol en natuurlike gasse in. Alkane is die belangrikste fossielbrandstof. Die verbranding van alkane (ook bekend as oksidasie) is hoogs eksotermies. |  |  |

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| 4.1 | Skryf 'n gebalanseerde vergelyking om die volledige verbrandingsreaksie van propaan te toon. |  | (3) |

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| 4.2 | Prop-1-een kan na ander verbindings omgeskakel word deur middel van verskillende organiese reaksies, wat deur **P**, **R**, **S** en **T** voorgestel word, soos hieronder getoon. |  |  |
|  | Alkohol  **P**  Prop-1-een  **R**  **T**  **S**  Alkaan  Haloalkaan  Cℓ 2 |  |  |
|  | Skryf die TIPE reaksie neer wat verteenwoordig word deur: |  |  |

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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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|  | Tydens reaksie **T** reageer die alkielhalied (haloalkaan) in die teenwoordigheid van 'n basis om 'n alkohol te vorm. |  |  |

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|  | 4.2.4 | Gee die NAAM van 'n geskikte basis wat gebruik is. |  | (1) |

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|  | 4.2.5 | Noem TWEE reaksietoestande wat nodig is. |  | (2)  **[12]** |

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| **VRAAG 5 (Begin op 'n nuwe bladsy.)** |  |  |
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| Die eienaar van 'n gebou het gekla oor die ondergrondse waterpype wat lek.  Die loodgieter het die ondergrondse waterpype opgegrawe en ontdek dat dit van yster gemaak is en verskeie gate gehad het. Om koste te laag te hou, is slegs die gedeeltes van die pyp wat gate gehad het, vervang. Nadat die lekkasie herstel is, het die loodgieter 'n sinkstaaf aan die ondergrondse ysterwaterpyp geheg en seker gemaak dat die sink met die ysterpyp kontak maak. |  |  |

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| 5.1 | Wat is die doel daarvan om die sinkstaaf aan die ysterpyp te heg? |  | (1) |

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| 5.2 | Gebruik die Tabel van Standaard-Reduksiepotensiale om die antwoord op VRAAG 5.1 te verduidelik. |  | (2) |

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| 5.3 | Gebruik die inligting wat vir 'n aantal halfreaksies uit die Tabel van Standaard-Reduksiepotensiale onttrek is om die vrae wat volg, te beantwoord.   |  |  | | --- | --- | | **Halfreaksies** | **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 | Identifiseer die substans/stof wat maklik gereduseer kan word. |  | (1) |

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|  | 5.3.2 | In 'n elektrolitiese sel, sou die substans/stof in VRAAG 5.3.1 die ANODE of die KATODE wees? |  | (1) |

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|  | 5.3.3 | Motiveer die antwoord op VRAAG 5.3.2. |  | (2) |

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|  | 5.3.4 | Skryf 'n gebalanseerde ioonvergelyking vir die reaksie tussen jodium en yster(III)ione (Fe3+). |  | (3) |

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| 5.4 | Kopermetaal word op groot skaal in die nywerheid gebruik. Onsuiwer koper wat deur myne gelewer word, kan deur elektrolise gesuiwer word, soos in die diagram hieronder getoon. |  |  |

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| Onsuiwer koper  Elektroliet  Suiwer koper | PSC1280 |  |  |

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|  | 5.4.1 | Definieer 'n *elektrolitiese sel*. |  | (2) |

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|  | 5.4.2 | Watter elektrode sal as die anode optree? (Skryf slegs ONSUIWER KOPER of SUIWER KOPER.) |  | (1) |

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|  | 5.4.3 | Watter reaksie vind by die anode plaas? |  | (1) |

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|  | 5.4.4 | Skryf die halfreaksie neer wat by die katode plaasvind. |  | (2) |

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|  | 5.4.5 | Watter oplossing kan as 'n elektroliet gebruik word? |  | (1) |
|  |  |  |  | **[17]** |

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| **VRAAG 6 (Begin op 'n nuwe bladsy.)** |

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| 6.1 | 'n Leerder het 'n elektrochemiese sel gebou met gebruik van koper- en sinkelektrodes. Die sel is opgestel soos hieronder geïllustreer. |  |  |
|  | V  Soutbrug      Cu-elektrode  Zn-elektrode            Cu2+ (aq)  Zn2+ (aq) |  |  |

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|  | 6.1.1 | Identifiseer die soort elektrochemiese sel wat in die diagram hierbo getoon word. |  | (1) |
|  | 6.1.2 | Watter energieomsetting vind in hierdie sel plaas? |  | (2) |
|  | 6.1.3 | Skryf TWEE funksies van die soutbrug neer. |  | (2) |
|  | 6.1.4 | Wat is die rigting van die elektronvloei? |  | (2) |
|  |  |  |  |  |
|  | 6.1.5 | Waarom is KNO3 die gewenste elektroliet om in plaas van BaCl2 in die soutbrug te gebruik? |  | (2) |

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| 6.2 | Vir hierdie sel: | |  |  |
|  | 6.2.1 | Skryf die netto reaksie neer. |  | (2) |

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|  | 6.2.2 | Gee die standaardtoestande. |  | (2) |

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|  | 6.2.3 | Skryf die selnotasie neer. |  | (3) |

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| 6.3 | **WATERSTOFAANGEDREWE MOTOR**  Die waterstofmotor, in Noorweë ontwikkel, gebruik elektriese stroom en waterstofgas in plaas van fossielbrandstowwe. Die instandhoudingsvrye batterye sorg vir 'n reikafstand van 125 km wat maklik aan daaglikse vervoerbehoeftes kan voldoen. Die batterye kan met gebruik van 'n kragprop gelaai word, of met 'n waterstof-brandstofsel terwyl 'n mens bestuur. Die waterstoftenk verdubbel die ryafstand na 250 km en kan binne 'n paar minute hervul word. Uiteindelik is 'n nul-uitlaatgasvoertuig beskikbaar.  [Bron: <http://www.pivco.no/content.php?id=40>] |  |  |

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|  | fuel-cell  Water  Oormaat waterstof (vir hergebruik)  Waterstof  Suurstof  Elektriese krag  Individuele brandstofsel wat in waterstof-aangedrewe motor gebruik word  Waterstofaangedrewe motor |  |  |

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|  | 6.3.1 | Gee TWEE uitlaatgasse wat gewone petrolaangedrewe motors kan produseer? |  | (2) |

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| 6.3.2 | Gee EEN: |  |  |

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|  | (a) | Voordeel van 'n waterstofaangedrewe motor |  | (1) |

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|  | (b) | Nadeel van 'n waterstofaangedrewe motor |  | (1) |
|  |  |  |  | **[20]** |

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| **VRAAG 7 (Begin op 'n nuwe bladsy.)** |  |  |

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| Gebruik die straaldiagram hieronder om die vrae te beantwoord. |  |  |

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|  | Voorwerp  20°  1  2  **B**  **A**  **C**  Beeld |  |  |

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| 7.1 | Skryf die NAAM neer van die verskynsel wat in die diagram hierbo geïllustreer word. |  | (1) |

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| 7.2 | Gee die rede waarom die ligstraal nie die oppervlak van die medium gepenetreer het nie. |  | (2) |
| 7.3 | Noem TWEE vereistes vir die verskynsel in die diagram hierbo. |  | (2) |

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| 7.4 | Gee geskikte NAME vir lyn **A**, **B** en **C**. | |  | (3) |
| 7.5 | Skryf die NAAM en die GROOTTE van die volgende neer: | |  |  |
|  | 7.5.1 | Hoek 1 |  | (2) |
|  |  |  |  |  |
|  | 7.5.2 | Hoek 2 |  | (2) |

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| 7.6 | Wanneer wit lig op 'n driehoekige prisma val, is 'n spektrum van sewe kleure sigbaar. |  |  |

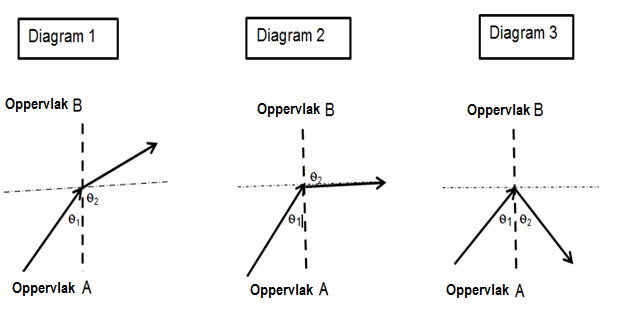
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| --- | --- | --- | --- | --- |
|  | 7.6.1 | Wat noem ons hierdie verskynsel? |  | (1) |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 7.6.2 | Watter kleur lig ondergaan die meeste refraksie? |  | (1) |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 7.6.3 | Verduidelik die antwoord op VRAAG 7.6.2 ten opsigte van die golflengte. |  | (2)  **[16]** |

|  |  |  |
| --- | --- | --- |
| **VRAAG 8 (Begin op 'n nuwe bladsy.)** |  |  |

|  |  |  |
| --- | --- | --- |
| Een van die praktiesste toepassings van totale interne weerkaatsing is in veseloptika. Bestudeer die diagramme hieronder en beantwoord die vrae wat volg. |  |  |



|  |  |  |  |
| --- | --- | --- | --- |
| 8.1 | Definieer r*efraksie.* |  | (2) |

|  |  |  |  |
| --- | --- | --- | --- |
| 8.2 | Identifiseer die verskynsel wat in Diagram 3 plaasvind. |  | (1) |

|  |  |  |  |
| --- | --- | --- | --- |
| 8.3 | Die oppervlakke in die diagramme hierbo het verskillende optiese digthede. |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 8.3.1 | Watter oppervlak is opties digter: oppervlak **A** of oppervlak **B**? |  | (1) |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 8.3.2 | Verduidelik die antwoord op VRAAG 8.3.1. |  | (2) |
|  |  | |  |  |
| 8.4 | 8.4.1 | In watter diagram, **1**, **2** of **3**, word die invalshoek die grenshoek genoem? |  | (1) |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 8.4.2 | Regverdig die antwoord op VRAAG 8.4.1. |  | (2) |

|  |  |  |  |
| --- | --- | --- | --- |
| 8.5 | Noem TWEE: |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 8.5.1 | Voorwaardes vir totale interne weerkaatsing |  | (2) |
|  |  |  |  |  |
|  | 8.5.2 | Toepassings van totale interne weerkaatsing |  | (2) |

|  |  |  |  |
| --- | --- | --- | --- |
| 8.6 | Bysiende mense kan nie voorwerpe wat ver is, sien nie omdat hulle oogballe te lank is. Dit veroorsaak dat lig van ver af voorwerpe voor die retina val en sodoende die beeld onduidelik maak. Om hierdie defek te korrigeer, skryf oogkundiges lense voor wat pasiënte in staat stel om ver af voorwerpe te sien.  Gebruik 'n benoemde diagram om te illustreer hoe so 'n lens bysiendheid sal korrigeer. |  | (5)  **[18]** |

|  |  |  |
| --- | --- | --- |
| **VRAAG 9 (Begin op 'n nuwe bladsy.)** |  |  |

|  |
| --- |
| Elektromagnetiese golwe het 'n golf- en 'n deeltjiegeaardheid en dit kan deur leë ruimte voortgeplant word. |

|  |  |  |  |
| --- | --- | --- | --- |
| 9.1 | Definieer 'n *elektromagnetiese golf*. |  | (2) |

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 9.2 | Die diagram hieronder verteenwoordig stralings van die elektromagnetiese spektrum.   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | Infrarooi | Radio- golwe | X-strale | Mikrogolwe | Gamma- strale | Ultraviolet strale | Sigbare lig | | |  |  |
|  | 9.2.1 | Rangskik die spektrum in volgorde van toenemende frekwensie. |  | (2) |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 9.2.2 | In watter straling sal 'n foton die hoogste energie hê? |  | (1) |
|  | 9.2.3 | Verduidelik die antwoord op VRAAG 9.2.2. |  | (2) |

|  |  |  |  |
| --- | --- | --- | --- |
| 9.3 | Bereken die energie van 'n foton van 'n elektromagnetiese golf met 'n golflengte van 470 nm. |  | (5) |

|  |  |  |  |
| --- | --- | --- | --- |
| 9.4 | Hoe sal die energie van 'n foton met 'n golflengte van 490 nm vergelyk met die berekende energie in VRAAG 9.3? (Skryf slegs GROTER AS, KLEINER AS of GELYK AAN). |  | (1) |
|  |  |  |  |
| 9.5 | Identifiseer die elektromagnetiese straling wat die geskikste vir gebruik in die volgende is: |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 9.5.1 | Sekuriteitsaftasters |  | (1) |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 9.5.2 | Sterilisering van kos en apparaat |  | (1) | |
|  |  | |  | | **[15]** |

|  |  |  |  |
| --- | --- | --- | --- |
|  | **TOTAAL:** |  | **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** | |