basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

SENIOR CERTIFICATE EXAMINATIONS/
NATIONAL SENIOR CERTIFICATE EXAMINATIONS
SENIORSERTIFIKAAT-EKSAMEN/
NASIONALE SENIORSERTIFIKAAT-EKSAMEN

TECHNICAL SCIENCES P2
TEGNIESE WETENSKAPPE V2

2019

MARKING GUIDELINES/*NASIENRIGLYNE*

MARKS/*PUNTE*: 150

These marking guidelines consist of 15 pages./
Hierdie nasienriglyne bestaan uit 15 bladsye.

QUESTION/*VRAAG* 1

1.1 B ✓✓ (2)

1.2 A ✓✓ (2)

1.3 D✓✓ (2)

1.4 D ✓✓ (2)

1.5 C ✓✓ (2)

1.6 B ✓✓ (2)

1.7 B ✓✓ (2)

1.8 D ✓✓ (2)

1.9 B ✓✓ (2)

1.10 A ✓✓ (2)

[20]

QUESTION/*VRAAG* 2

2.1 (Molecules) containing carbon atoms. ✓✓
(Molekules) wat koolstofatome bevat. (2)

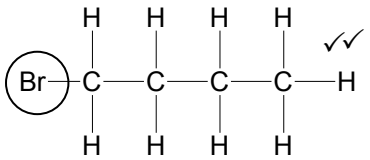
2.2.1 D ✓ (1)

2.2.2 B ✓ (1)

2.2.3 A ✓ (1)

2.2.4 F ✓ (1)

2.2.5



✓✓

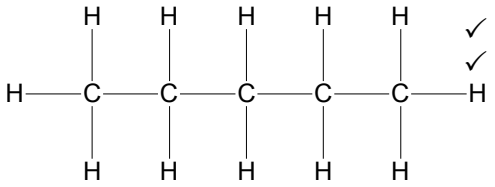
Marking guidelines/*Nasienriglyne:*
- Whole structure correct. ✓✓
  Hele struktuur korrek

(2)

2.2.6 1- bromo✓butane✓
1-bromobutaan (2)

NOTE: Penalise if the hyphen is omitted or in an incorrect position.
LET WEL: *Penaliseer indien die koppelteken uitgelaat is of in 'n verkeerde posisie.*

2.2.7



✓
✓

- **Marking guidelines/*Nasienriglyne:***
- Whole structure correct. ✓✓
  Hele struktuur korrek.

NOTE/*LET WEL*:

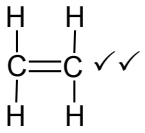
- One hydrogen atom missing, max 1/2
- A bond missing, max ½.
- *'n Waterstofatoom uitgelaat, maks ½*
- *'n Binding uitgelaat, maks ½.*

(2)

2.3.1 Small organic molecules that can be covalently bonded to each other ✓ in a repeating pattern. ✓
Klein organiese molekules wat kovalent aan mekaar gebonde kan wees, in 'n herhalende patroon. (2)

2.3.2 (Addition) polymerisation. ✓
(Addisie) polimerisasie. (1)

2.3.3



✓✓

(2)
[17]

QUESTION/*VRAAG* 3

3.1 The pressure exerted by a vapour at equilibrium with its liquid ✓ in a closed system.✓
Die druk wat deur 'n gas in ewewig/ekwilibrium met sy vloeistof, in 'n geslote stelsel uitgeoefen word. (2)

3.2 C_5H_{12} ✓✓
Note: Penalise with one mark for each incorrect answer.
Let wel: *Penaliseer met een punt vir elke verkeerde antwoord* (2)

3.3 Chain (isomers). ✓
Ketting (isomere). (1)

3.4 Induced dipole OR London forces/momentary/dispersion. ✓
Geïnduseerde dipool OF London-kragte/kortstondige/dispersie. (1)

3.5 It increases from **A** to **C/**top to bottom ✓
*Dit verhoog van **A** na **C**/bo na onder.*

Accept:
- Vapour pressure decreases from **C** to **A.**
- Vapour pressure decrease with decrease in branching (of hydrocarbons).

Aanvaar:
- *Dampdruk verlaag van **C na A.***
- *Dampdruk verlaag met afname in vertakking (van die koolwaterstowwe).*

OR/*OF*
- Vapour pressure increases with increase in branching (of hydrocarbons).
- *Dampdruk verhoog met toename in vertakking (van koolwaterstowwe)* (1)

3.6
- Branching increases from **A** to **C** ✓ /Chain length decreases from **A** to **C**
- An increase in branching decreases the strength of the intermolecular forces (induced dipole/London forces). ✓
- As the (strength of) intermolecular forces decreases, the vapour pressure increases. ✓

OR
- Branching decreases from **C** to **A**. /Chain length increases from **C** to **A**
- A decrease in branching increases the strength of the intermolecular forces (induced dipole/London forces).
- As the (strength of) intermolecular forces increase, the vapour pressure decreases.

OR
- Surface area decreases from **A** to **C** ✓
- A decrease in surface area decreases the strength of the intermolecular forces (induced dipole/London forces). ✓
- As the intermolecular forces decreases, the vapour pressure increases. ✓

OR
- Surface area increases from **C** to **A**
- A increase in surface area increases the strength of the intermolecular forces (induced dipole/London forces).
- As the intermolecular forces increase, the vapour pressure decreases. (3)

- *Vertakking word meer van **A** na **C**./ Kettinglengte korter van **A** na **C**.*
- *Meer vertakking, verminder/verlaag die sterkte van die intermolekulêre kragte (geïnduseerde dipool/London-kragte).*
- *Soos die intermolekulêre kragte verminder, verhoog die dampdruk.*

OF

- *Vertakking word minder van **C** na **A**./ Kettinglengte langer van **C** na **A**.*
- *Minder vertakking verhoog/vermeerder die sterkte van die intermolekulêre kragte (geïnduseerde dipool/London-kragte).*
- *As die intermolekulêre kragte vermeerder, verlaag die dampdruk*

OF

- *Oppervlakarea verminder van **A** na **C**.*
- *'n Verlaging in opervlakarea verminder die sterkte van die intermolekulêre kragte (geïnduseerde dipool/London-kragte)*
- *Soos die intermolekulêre kragte verminder, verhoog die dampdruk.*

OF

- *Oppervlakarea vergroot van **C** na **A**.*
- *'n Verhoging A increase in opervlakarea verhoog die sterkte van die intermolekulêre kragte (geïnduseerde dipool/London-kragte).*
- *Soos die intermolekulêre kragte vermeerder, verlaag die dampdruk.*

3.7 **A** ✓ (1)

3.8 **Negative marking from Question 3.7.**
Negatiewe nasien van Vraag 3.7

The lower the vapour pressure, the higher the boiling point. ✓✓
Hoe laer die dampdruk, hoe hoër die kookpunt.

OR/*OF*
The higher the vapour pressure, the lower the boiling point.
Hoe hoër die dampdruk, hoe laer die kookpunt.

OR/*OF*
The vapour pressure increases with a decrease in boiling point.
Die dampdruk verhoog met 'n afname in kookpunt.
OR
Because **A** has the lower vapour pressure.

Accept: the lowest pressure means the substance does not boil quickly
***Aanvaar**: die laagste druk beteken die substanse kook nie so vinnig nie.* (2)

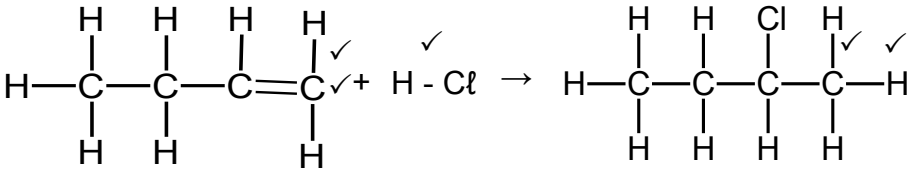
[13]

QUESTION/*VRAAG* 4

4.1.1 Addition/Hydrogenation ✓
Addisie/Hidrogenering (1)

4.1.2 Substitution/hydrolysis ✓
Substitusie/hidrolise (1)

4.1.3 Addition/Hydration ✓
Addisie/hidrasie (1)

4.2.1 

Marking guidelines/*Nasienriglyne:*
- Structural formula of alkene correct. ✓✓
  Struktuurformule van alkeen korrek.
- Structural formula of HCℓ ✓
  Struktuurformule van HCℓ
- Structural formula of haloalkane ✓ ✓
  Struktuurformule van haloalkaan korrek.

Accept if but-2-ene is used as starting reactant.
Aanvaar indien but-2-een as aanvangsreaktans gebruik is.

NB: Any hydrogen atoms or bond missing, max ½.
Enige waterstofatome of bindinge uitgelaat, maks ½.
Do not penalise if HCℓ is used.
Moet NIE penaliseer indien HCℓ gebruik is.

(5)

4.2.2 No water/*Geen water*. ✓
No reactive/inert solvent/*Geen reaktiewe oplosmiddel nie*.

Any ONE/*Enige EEN* (1)

4.3.1 Butane/*Butaan* ✓✓ (2)

4.3.2 Pt/Platinum ✓
Ni/Nickel/*Nikkel* ✓ ANY TWO/*Enige TWEE*
Pd/Paladium (2)

4.4.1 Combustion/oxidation/*Verbranding/oksidasie* ✓ (1)

4.4.2 Carbon dioxide/CO_2/carbon (IV) oxide/*Koolstofdioksied/Koolstof(IV) oksied* ✓
Water/H_2O ✓
Note: Award a full marks if the correct combustion reaction is written
LET WEL: Ken volpunte toe indien korrekte verbrandingsreaksie neergeskryf is. (2)

[16]

QUESTION/*VRAAG* 5

5.1 Electrolytic (cell). ✓
Elektrolitiese (sel) (1)

5.2 Electrical (energy) to chemical (energy). ✓✓
Elektriese (energie) na chemiese (energie). (2)

5.3.1 **A**/Electrode connected to the positive terminal of the battery. ✓
***A**/Elektrode verbind aan die positiewe terminaal van die battery.*
Accept: electrode connected to the left.
***Aanvaar**: elektrode wat links verbind is.* (1)

5.3.2 **B**/Electrode connected to the negative terminal of the battery ✓
***B**/Elektrode verbind aan die negatiewe terminaal van die battery.*
Accept: electrode connected to the right.
***Aanvaar**: elektrode wat regs verbind is.* (1)

5.4.1 $2C\ell^- \rightarrow C\ell_2 + 2e^-$ ✓✓ (2)

Marking guidelines/*Nasienriglyne:*
$2C\ell^- \rightleftharpoons C\ell_2 + 2e^-$ $(\frac{1}{2})$
$2C\ell^- \leftarrow C\ell_2 + 2e^-$ $(\frac{0}{2})$
$C\ell_2 + 2e^- \leftarrow 2C\ell^-$ $(\frac{2}{2})$
$C\ell_2 + 2e^- \rightleftharpoons 2C\ell^-$ $(\frac{0}{2})$

5.4.2 $Cu^{2+} + 2e^- \rightarrow Cu$ ✓✓ (2)

Marking guidelines/*Nasienriglyne:*
$Cu^{2+} + 2e^- \rightleftharpoons Cu^-$ $(\frac{1}{2})$
$Cu \leftarrow Cu^{2+} + 2e^-$ $(\frac{2}{2})$
$Cu^{2+} + 2e^- \leftarrow Cu$ $(\frac{0}{2})$
$Cu \rightleftharpoons Cu^{2+} + 2e^-$ $(\frac{0}{2})$

5.5 Non-spontaneous ✓
Nie-spontaan (1)

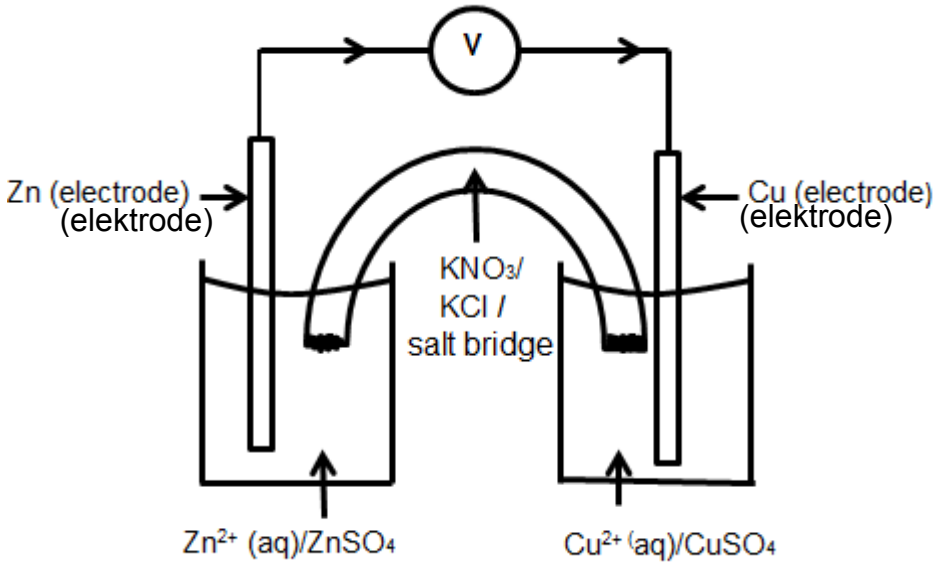
5.6 **Negative marking from Question 5.5.**
Negatiewe nasien vanaf Vraag 5.5

Electric current/electrical energy is required for a reaction to occur. ✓✓
Elektriese stroom/elektriese energie is nodig vir 'n reaksie om plaas te vind.
***Accept**:* Electric current is required to produce chemical change.
E^o cell negative.
***Aanvaar**: Elektriese stroom nodig om chemiese verandering te veroorsaak.*
E^o sel negatief. (2)

[12]

QUESTION/*VRAAG* 6

6.1



Marking guideline/*Nasienriglyne:*	**Marks/ Punte**
Zinc/ Zn (electrode/*elektrode)*	✓
Copper /Cu (electrode/*elektrode)*	✓
Zn electrode inside $ZnSO_4$ /Zn^{2+} solution *Zn electrode binne $ZnSO_4$ /Zn^{2+} oplossing*	✓
Cu electrode inside $CuSO_4$ / Cu^{2+} solution *Cu electrode binne $CuSO_4$ / Cu^{2+} oplossing*	✓
Salt bridge/KNO_3/KCℓ correctly connected and indicated (formula or name of electrolyte accepted) *Soutbrug*/KNO_3/KCℓ *korrek verbind en aangetoon met elektroliet (formule of naam van elektroliet aanvaar)* **Accept***:* Salt solution ***Aanvaar****:* *Sout oplossing* **Note**: If one container, no marks for salt bridge ***Let wel****: indien een houer, geen punte vir soutbrug*	✓
Voltmeter/galvanometer connected in the external circuit *Voltmeter/galvanometer in eksterne stroombaan verbind*	✓
Direction of flow of electrons indicated (from zinc to copper) in external circuit *Rigting van elektrone (van sink na koper) in eksterne stroombaan aangetoon*	✓

(7)

6.2 The loss of electrons./ *Die verlies aan elektrone* ✓✓
Accept: Increase in oxidation number.
Aanvaar: *Verhoging in oksidasiegetal* (2)

6.3.1 Zn/ Zinc/*Sink* ✓ (1)

6.3.2 Cu (II) ions/*ione* (Cu^{2+})/copper ions/*koperione* ✓ (1)

6.4.1 Zn (s) + Cu^{2+}(aq) ✓→ Zn^{2+}(aq) + Cu(s) ✓ Balancing/*Balansering* ✓
NOTE: Do not penalise if phases are not shown.
LET WEL: *Moet nie penaliseer indien fases nie getoon is nie.* (3)

6.4.2 $Zn(s)|Zn^{2+}(aq)$ ✓||✓$Cu^{2+}(aq)|Cu(s)$ ✓

OR/*OF*
$Zn(s)|Zn^{2+}(1\ mol.dm^{-3})$ ✓||✓$Cu^{2+}(1\ mol.dm^{-3})|Cu(s)$ ✓

NOTE: Do not penalise if phases and concentration are not shown.
LET WEL: *Moet nie penaliseer indien fases/konsentrasie nie getoon is nie.* (3)

6.5 Temperature/*Temperatuur* = 298 K / 25 ^{o}C ✓
Concentration of electrolyte/*Konsentrasie van elektroliet* = 1 mol·dm^{-3} ✓ (2)

6.6

OPTION/*OPSIE* 1:	**OPTION/*OPSIE* 2:**
$E^{\Theta}_{cell} = E^{\Theta}_{reduction} - E^{\Theta}_{oxidation}$ ✓ $E^{\Theta}_{sel} = E^{\Theta}_{reduksie} - E^{\Theta}_{oksidasie}$ = (0,34 ✓) - (-0,76 ✓) = 1,1 V ✓ **Note**: use any correct formula given in information sheet. ***LET WEL**: gebruik enige van die formules in die inligtingsblad.*	$Zn \rightarrow Zn^{2+} + 2e^-$ ✓ -(-0,76 V) ✓ $Cu^{2+} + 2e^- \rightarrow Cu$ ✓ (+0,34 V) ✓ $Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu$ 1,1 V ✓

(4)

[23]

QUESTION/*VRAAG* 7

7.1.1 Refraction / (*Lig)breking* ✓ (1)

7.1.2 **Negative marking from Question 7.1.1.**
Negatiewe nasien vanaf Vraag 7.1.1.

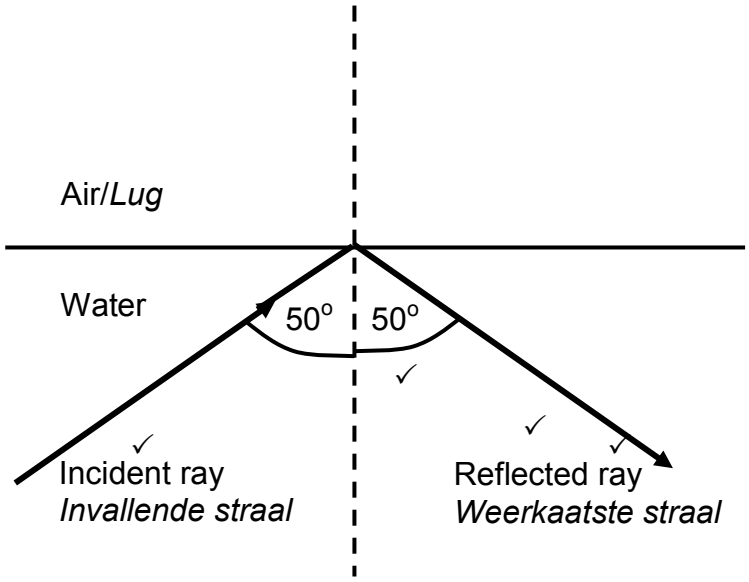
The speed/wavelength of the light ray decreases, ✓ and light ray bends towards the normal in the new medium. ✓
Die spoed/golflengte van die ligstraal verminder en buig na die normaal toe in die nuwe medium. (2)

7.2 Is the angle of incidence, where the angle of refraction is 90^{o} ✓ and the light must travel from an optically denser medium to an optically less dense medium. ✓
Is die invalshoek waar die brekingshoek 90^{o} is en die lig moet van 'n opties meer digte na 'n opties minder digte medium beweeg.

OR/*OF*
The angle of incidence in the denser medium ✓ is such that the refracted ray just passes between the surface (of separation) of two media ✓
Die invalshoek in die digter medium is sodanig dat die gebreekte straal presies op die vlak wat die twee media skei, beweeg. (2)

7.3
- A ray of light must move from a medium with high optical density/medium with high refractive index to a medium of low optical density/low refractive index. ✓
  'n Ligstraal moet van 'n medium met 'n hoër optiese digtheid/medium met hoër refraktiewe indeks, na 'n medium met 'n laer optiese digtheid/laer refrakiewe indeks beweeg.
- Angle of incidence must be greater than the critical angle (of that media). ✓
  Invalshoek moet groter as die grenshoek vir daardie medium wees. (2)

7.4



Marking Criteria/*Nasienriglyne*	**Marks/ *Punte***
Diagram must indicate total internal reflection. ***Diagram moet totale interne weerkaatsing toon.***	
Incident ray correctly labelled, with direction./*Invallende straal korrek benoem, met rigting.*	✓
Reflected ray correctly labelled, with direction./*Weerkaatste straal korrek benoem, met rigting.*	✓
Both angles (angles of incidence and reflected angle) equal to 50°. *Beide hoeke (invalshoek en weerkaatsingshoek gelyk aan 50°.)*	✓
Both rays (incidence ray and reflected ray) indicated correctly and rays are in the same medium (water). *Beide strale (invallende straal en weerkaatste straal) korrek aangetoon en strale in dieselfde medium (water).*	✓

(4)

7.5.1 Dispersion/*Dispersie* ✓ (1)

7.5.2 Seven/*Sewe* (7) ✓ (1)

7.5.3 Violet ✓ (1)

7.5.4 Decreases/ *Afneem* ✓ (1)

7.5.5 **Negative marking from Question 7.5.4.**
Negatiewe nasien vanaf Vraag 7.5.4.
Light moves from an optically less dense medium to an optically denser medium. ✓ The <u>speed decreases</u>. ✓
Lig beweeg van 'n opties minder digte medium na 'n opties meer digte medium. Die spoed verminder (omdat die golflengte langer word). (2)

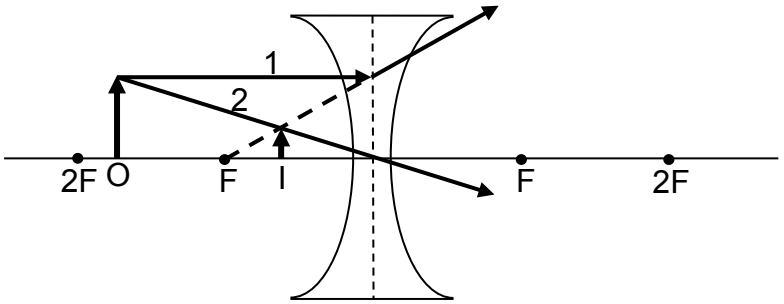
7.6 $v = f\lambda$ ✓ $f = \frac{(3 \times 10^8)}{(2{,}63 \times 10^{-7})}$ ✓ ✓ $= 1{,}14 \times 10^{15}$ Hz ✓

Accept: **c** instead of **v** for speed. (4)
***Aanvaar**: **c** in plaas van **v** vir spoed.* **[21]**

QUESTION/*VRAAG* 8

8.1 Convex /Converging (lens) ✓
Konvekse/konvergerende (lens). (1)

8.2.1



Marking criteria/*Nasienriglyne*:		**Marks/ *Punte***
Ray 1: ***Straal 1:***	A ray entering the concave lens parallel to its axis, diverges. *'n Straal wat die konkawe lens, parallel aan sy as binnekom, divergeer.*	✓
Ray 2: ***Straal 2:***	A ray passing through the optical centre of the concave lens, does not change direction. *'n Straal wat deur die optiese middelpunt van die konkawe lens beweeg, verander nie van rigting nie.*	✓
I: ***I:***	Image is smaller and upright, at the point where ray **2** and extrapolation of ray **1** meet. *Beeld is kleiner en regop, by punt waar straal **2** en ekstragepoleerde straal **1** ontmoet.*	✓
O: ***O:***	Position of object between **F** and **2F**. *Posisie van voorwerp tussen **F** en **2F**.*	✓
I: ***I:***	Position of image is between **F** and the lens on same side of lens as object. *Posisie van beeld is tussen **F** en die lens aan dieselfde kant van die lens as die voorwerp.*	✓

(5)

8.2.2
- Smaller than object OR diminished/ *Kleiner as die voorwerp*. ✓
- Upright or Erect / *Regop* ✓
- On the same side of the lens as the object / *Aan dieselfde kant as die voorwerp.*✓
- Virtual/*Virtueel*

Any THREE/*Enige DRIE* (3)

8.2.3 Larger/*Groter* as ✓ (1)

8.3 Myopia/near-sightedness/short sighted / *Miopia/bysiende/nabysiende* ✓ (1)

8.4

Convex lens	Concave lens
• A convex lens is thick in the middle and thin at the edges. ✓	• A concave lens is thin in the middle and thick at the edges. ✓
• It is converging in nature.	• It is diverging in nature
• A convex lens forms a real image.	• A concave lens forms a virtual image.
• Correct hypermetropia/ hyperopia/long sightedness.	• Correct myopia/shortsightedness.
• Objects appear closer and larger.	• Objects appear smaller and farther.

Any ONE difference.
Note: **Compare same property between two lenses for 2 marks.**

Konveks lens	Konkawe lens
• *'n Konvekse lens is dikker in die middel en dun by die kante.*	• *'n Konkawe lens is dunner in die middel en dik by die kante.*
• *Dit is konvergerend van aard.*	• *Dit is divergerend van aard.*
• *'n Konvergerende lens vorm 'n ware beeld.*	• *'n Konkawe lens vorm 'n skynbeeld.*
• *Korrigeer hipermetropia/ hipermiopia/versiende*	• *Korrigeer miopia/nabysiende*
• *Voorwerp lyk nader en groter*	• *Voorwerpe lyk kleiner en verder*

(2)

Enige EEN verskil.
Let wel**: **Vergelyk dieselfde eienskap tussen die twee lense vir 2 punte.

[13]

QUESTION/*VRAAG* 9

9.1 Electromagnetic waves:
- Self propagating.
- do not need a material medium to be propagated. / can be propagated through a vacuum. ✓
- when moving through a material medium they can interact with the medium and transfer energy to the medium. ✓
- can be polarised.
- are transverse waves.
- have dual nature/behave both as wave and a particle.
- travels at a speed of 3×10^8 $m \cdot s^{-1}$ in a vacuum.

Elektromagnetiese golwe:
- *self propagerend.*
- *benodig nie 'n materiële medium om voort te plant nie. / kan deur 'n vakuum beweeg.*
- *wanneer deur 'n materiële medium beweeg, kan hulle met die medium in interaksie gaan en energie na die medium oordra.*
- *kan gepolariseer word.*
- *is transversale golwe.*
- *het 'n dubbele aard/kan beide as golf en deeltjie optree.*
- *beweeg teen 'n spoed van 3×10^8 $m \cdot s^{-1}$ in 'n vakuum.*

Any TWO/*Enige TWEE* (2)

9.2 It is a quantum of energy/small package of energy. ✓✓
Dit is 'n kwantum energie/klein pakkie of hoeveelheid energie (2)

9.3 **A:** micro wave/*mikrogolwe* ✓
B: Visible light/*sigbare lig* ✓
C: Ultraviolet ✓
D: Gamma rays/*strale* ✓ (4)

9.4 Gamma rays/*strale/D* ✓ (1)

9.5
- X-rays examine the inside of the body, for example: see broken bones. ✓
- Used for security purposes to detect hidden objects. ✓

Accept:
- Chest X-rays may be used to diagnose and treat lung cancer.
- Low dosage X-rays may be used to construct images of structures inside the body to detect a tumour.
- Higher doses, X-rays may be used in radiation therapy to help destroy cancerous cells in the body.
- Use X-rays to determine defects in, for example materials, in the construction industry.
-

- *X-strale word gebruik om die liggaam van binne te ondersoek, bv. om gebreekte bene te sien.*
- *Word gebruik vir sekuriteitsdoeleindes om versteekte voorwerpe op te spoor.*

Aanvaar:

- Borskas X-strale kan vir diagnose en die behandeling van longkanker gebruik word.
- In lae dosis X-rays kan gebruik word om 'n beeld van 'n tumor in die ligaam te verkry
- In hoë dosisse , X-strale kan tydens bestralingsterapie gebruik word om kankerselle in die liggaam te vernietig
- Gebruik X-strale om oa. materiaal defekte in die konstruksie industrie op te spoor. (2)

9.6 $E = hf$ ✓

$E = (6{,}63 \times 10^{-34})(3{,}2 \times 10^{10})$ ✓ ✓

$E = 2{,}12 \times 10^{-23}$ J✓

(4)
[15]

TOTAL/*TOTAAL*: 150