

SA's Leading Past Year

Exam Paper Portal

STUDY

You have Downloaded, yet Another Great Resource to assist you with your Studies 😊

Thank You for Supporting SA Exam Papers

Your Leading Past Year Exam Paper Resource Portal

Visit us @ [www.saexampapers.co.za](http://www.saexampapers.co.za)



SA EXAM  
PAPERS



# 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**

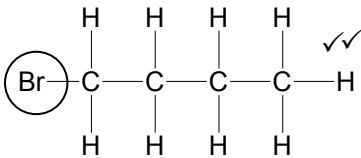
**MARKS/PUNTE: 150**

**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]**

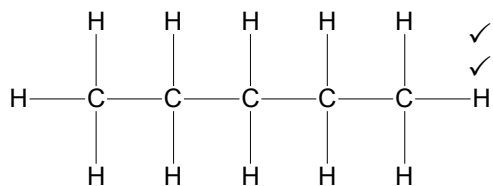
### QUESTION/VRAAG 2

- 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  ✓✓ (2)
- Marking guidelines/Nasienriglyne:**

  - Whole structure correct. ✓✓  
Hele struktuur korrek
- 2.2.6 1-bromobutane ✓  
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 1/2.
- 'n Waterstofatoom uitgelaat, maks 1/2
- 'n Binding uitgelaat, maks 1/2.

(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.

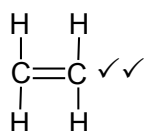
(2)

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 oppervlakarea 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 oppervlakarea 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 substansie kook nie so vinnig nie.

(2)

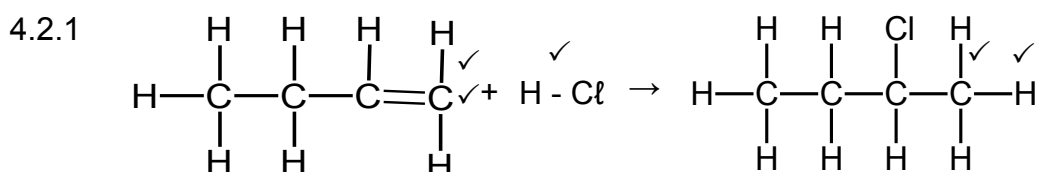
**[13]**

### 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)



**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.

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<sub>2</sub>/carbon (IV) oxide/Koolstofdioksied/Koolstof(IV) oksied ✓  
 Water/H<sub>2</sub>O ✓  
**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)

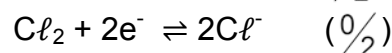
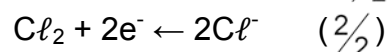
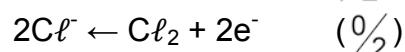
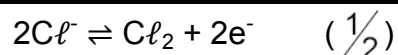
5.2 Electrical (energy) to chemical (energy). ✓✓  
*Elektriese (energie) na chemiese (energie).* (2)

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)

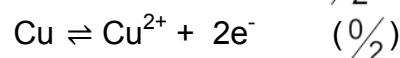
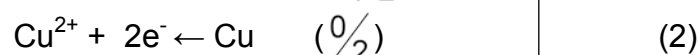
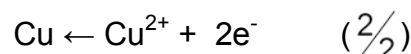
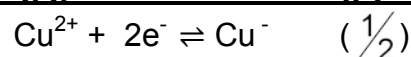
5.4.1  $2\text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-$  ✓✓ (2)

**Marking guidelines/Nasienriglyne:**



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

**Marking guidelines/Nasienriglyne:**



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.

$E^\circ$  cell negative.

**Aanvaar:** *Elektriese stroom nodig om chemiese verandering te veroorsaak.*

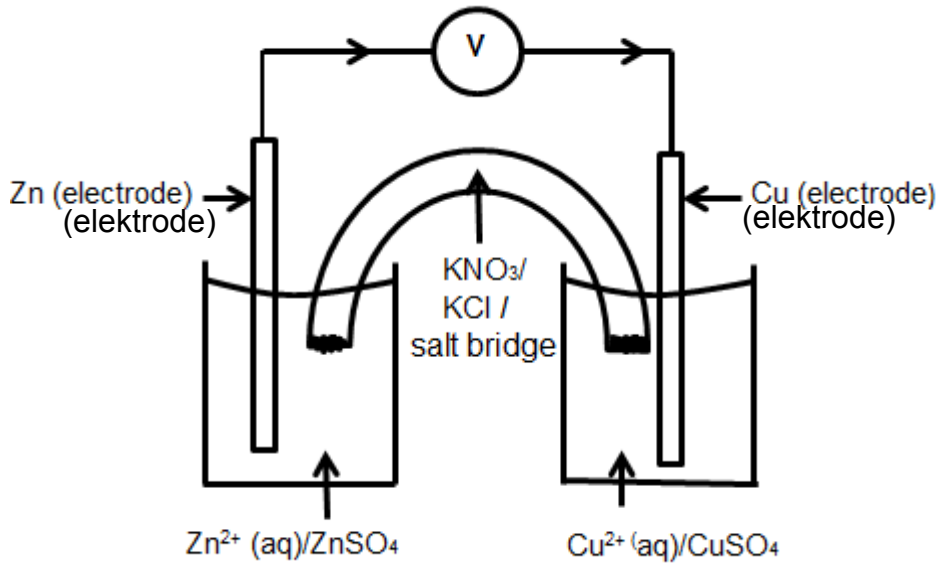
$E^\circ$  sel negatief. (2)

[12]



**QUESTION/VRAAG 6**

6.1



Marking guideline/Nasienriglyne:	Marks/Punte
Zinc/ Zn (electrode/elektrode)	✓
Copper /Cu (electrode/elektrode)	✓
Zn electrode inside ZnSO <sub>4</sub> /Zn <sup>2+</sup> solution <i>Zn electrode binne ZnSO<sub>4</sub> /Zn<sup>2+</sup> oplossing</i>	✓
Cu electrode inside CuSO <sub>4</sub> / Cu <sup>2+</sup> solution <i>Cu electrode binne CuSO<sub>4</sub> / Cu<sup>2+</sup> oplossing</i>	✓
Salt bridge/KNO <sub>3</sub> /KCl correctly connected and indicated (formula or name of electrolyte accepted) <i>Soutbrug/KNO<sub>3</sub>/KCl korrek verbind en aangetoon met elektroliet (formule of naam van elektroliet aanvaar)</i> <b>Accept:</b> Salt solution <b>Aanvaar:</b> Sout oplossing <b>Note:</b> If one container, no marks for salt bridge <b>Let wel:</b> indien een houër, geen punte vir soutbrug	✓
Voltmeter/galvanometer connected in the external circuit <i>Voltmeter/galvanometer in eksterne stroombaan verbind</i>	✓
Direction of flow of electrons indicated (from zinc to copper) in external circuit <i>Rigting van elektrone (van sink na koper) in eksterne stroombaan aangetoon</i>	✓

(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<sup>2+</sup>)/copper ions/koperione ✓

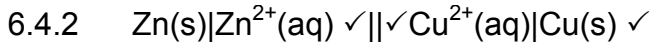
(1)

6.4.1 Zn (s) + Cu<sup>2+</sup>(aq) ✓ → Zn<sup>2+</sup>(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)



**OR/OF**



**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 °C ✓

Concentration of electrolyte/ *Konsentrasie van elektroliet* = 1 mol·dm<sup>-3</sup> ✓ (2)

6.6

OPTION/OPSIE 1:	OPTION/OPSIE 2:
$E^{\ominus}_{\text{cell}} = E^{\ominus}_{\text{reduction}} - E^{\ominus}_{\text{oxidation}} \checkmark$ $E^{\ominus}_{\text{sel}} = E^{\ominus}_{\text{reduksie}} - E^{\ominus}_{\text{oksidasie}}$ $= (0,34 \checkmark) - (-0,76 \checkmark)$ $= 1,1 \text{ V} \checkmark$ <p><b>Note:</b> use any correct formula given in information sheet.  <b>LET WEL:</b> <i>gebruik enige van die formules in die inligtingsblad.</i></p>	$\left. \begin{array}{l} \text{Zn} \rightarrow \text{Zn}^{2+} + 2\text{e}^{-} \\ \text{Cu}^{2+} + 2\text{e}^{-} \rightarrow \text{Cu} \end{array} \right\} \checkmark$ $\begin{array}{l} -(-0,76 \text{ V}) \checkmark \\ (+0,34 \text{ V}) \checkmark \end{array}$ $\text{Zn} + \text{Cu}^{2+} \rightarrow \text{Zn}^{2+} + \text{Cu} \quad 1,1 \text{ V} \checkmark$

(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  $90^\circ$  ✓ and the light must travel from an optically denser medium to an optically less dense medium. ✓

Is die invalshoek waar die brekingshoek  $90^\circ$  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)

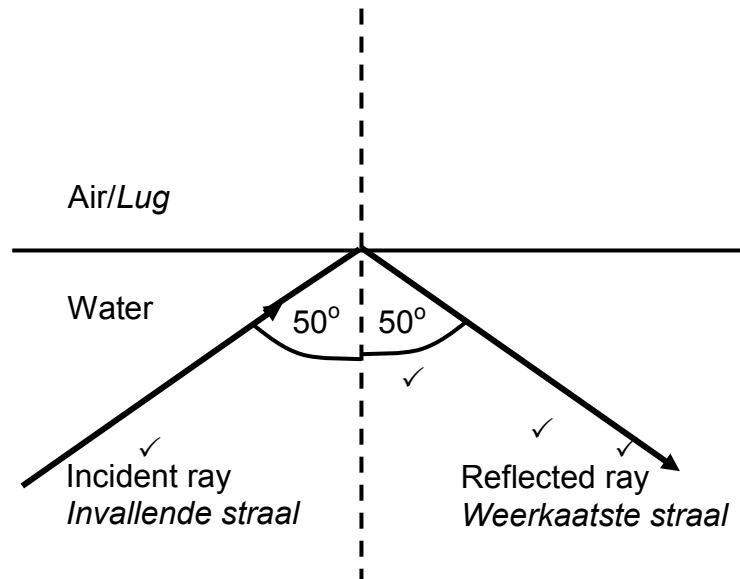
7.3 • A ray of light must move from a medium with high optical density/medium with high refractive index to a medium of low optical density/low refractive index. ✓

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

(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 speed decreases. ✓

*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

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

**Accept: c** instead of **v** for speed.

**Aanvaar: c** in plaas van **v** vir spoed.

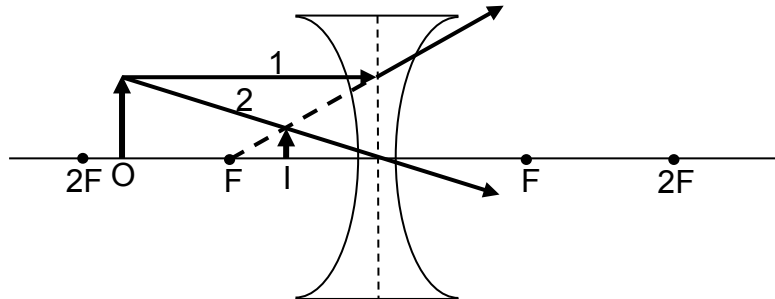
(4)

[21]

**QUESTION/VRAAG 8**

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

8.2.1



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

8.4

Convex lens	Concave lens
<ul style="list-style-type: none"> <li>A convex lens is thick in the middle and thin at the edges. ✓</li> </ul>	<ul style="list-style-type: none"> <li>A concave lens is thin in the middle and thick at the edges. ✓</li> </ul>
<ul style="list-style-type: none"> <li>It is converging in nature.</li> </ul>	<ul style="list-style-type: none"> <li>It is diverging in nature</li> </ul>
<ul style="list-style-type: none"> <li>A convex lens forms a real image.</li> </ul>	<ul style="list-style-type: none"> <li>A concave lens forms a virtual image.</li> </ul>
<ul style="list-style-type: none"> <li>Correct hypermetropia/ hyperopia/long sightedness.</li> </ul>	<ul style="list-style-type: none"> <li>Correct myopia/shortsightedness.</li> </ul>
<ul style="list-style-type: none"> <li>Objects appear closer and larger.</li> </ul>	<ul style="list-style-type: none"> <li>Objects appear smaller and farther.</li> </ul>

Any ONE difference.

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

Konveks lens	Konkawe lens
<ul style="list-style-type: none"> <li>'n Konvekse lens is dikker in die middel en dun by die kante.</li> </ul>	<ul style="list-style-type: none"> <li>'n Konkawe lens is dunner in die middel en dik by die kante.</li> </ul>
<ul style="list-style-type: none"> <li>Dit is konvergerend van aard.</li> </ul>	<ul style="list-style-type: none"> <li>Dit is divergerend van aard.</li> </ul>
<ul style="list-style-type: none"> <li>'n Konvergerende lens vorm 'n ware beeld.</li> </ul>	<ul style="list-style-type: none"> <li>'n Konkawe lens vorm 'n skynbeeld.</li> </ul>
<ul style="list-style-type: none"> <li>Korrigeer hipermetropia/ hipermiopia/versiende</li> </ul>	<ul style="list-style-type: none"> <li>Korrigeer miopia/nabysie</li> </ul>
<ul style="list-style-type: none"> <li>Voorwerp lyk nader en groter</li> </ul>	<ul style="list-style-type: none"> <li>Voorwerpe lyk kleiner en verder</li> </ul>

(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  $3 \times 10^8 \text{ m}\cdot\text{s}^{-1}$  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  $3 \times 10^8 \text{ m}\cdot\text{s}^{-1}$  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 liggaam 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

$$E = hf \checkmark$$

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

$$E = 2,12 \times 10^{-23} \text{ J} \checkmark$$

(4)

**[15]**

**TOTAL/TOTAAL: 150**