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

2021

MARKING GUIDELINES/*NASIENRIGLYNE*

MARKS/*PUNTE*: 150

These marking guidelines consist of 16 pages./
Hierdie nasienriglyne bestaan uit 16 bladsye.

QUESTION/*VRAAG* 1

1.1 D ✓✓ (2)

1.2 A ✓✓ (2)

1.3 B ✓✓ (2)

1.4 C ✓✓ (2)

1.5 C ✓✓ (2)

1.6 A ✓✓ (2)

1.7 D ✓✓ (2)

1.8 B ✓✓ (2)

1.9 C ✓✓ (2)

1.10 B ✓✓ (2)

[20]

QUESTION/*VRAAG* 2

2.1 Is a series of (organic) compounds (molecules) that has the same general formula (and the same functional group), ✓ where each member differs from the previous member by a $–CH_2$ group. ✓

'n Reeks (organiese) verbindings (molekules) wat deur dieselfde algemene formule (en dieselfde funksionele groep) beskryf kan word en waar een lid van die vorige met 'n CH_2 - groep verskil. (2)

2.2.1 C ✓ (1)

2.2.2 D ✓ (1)

2.2.3 A ✓ (1)

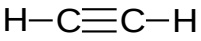
2.2.4 B ✓ (1)

2.2.5 E ✓ (1)

2.3 Propanal/*Propanaal* ✓ (1)

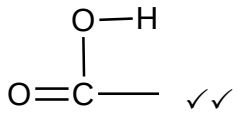
2.4 A ✓ **OR/*OF*** ethyne/*etyn*

OR/*OF*



(1)

2.5.1



✓✓

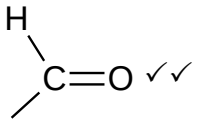
Marking criteria/*Nasienriglyne:*

- If the bonds are missing 0/2
- If hydrogen atoms are added/missing 0/2
- If a structural formula of a compound is given and functional group is encircled 2/2

- *Indien bindings uitgelaat is 0/2*
- *Indien waterstofatome bygevoeg/uitgelaat is 0/2*
- *Indien die strukturele formule van 'n verbinding gegee is en die funksionele groep omsirkel is 2/2*

(2)

2.5.2



✓✓

Marking criteria/*Nasienriglyne:*

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- *Indien waterstofatome bygevoeg/uitgelaat is 0/2*
- *Indien die strukturele formule van 'n verbinding gegee is en die funksionele groep omsirkel is 2/2*

(2)

2.6

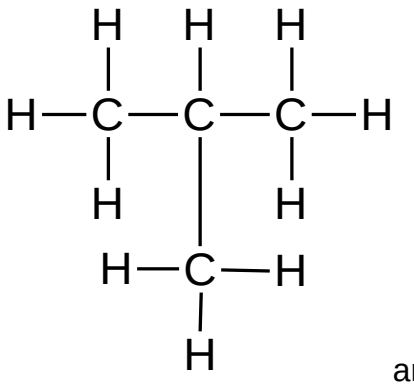
- Chain isomers are organic compounds with the same molecular formula, but different types of chains/chain lengths. ✓✓
- Positional isomers are organic compounds with the same molecular formula, but different positions of the side chain, substituents or functional groups on the parent chain. ✓✓

- *Ketting-isomere is organiese verbindings met dieselfde molekulêre formule, maar verskillende tipes kettings/kettinglengtes.*
- *Posisionele isomere is organiese verbindings met dieselfde molekulêre formule, maar verskillende posisies van die syketting, substituente of funksionele groepe op die ouerketting.*

(4)

2.7.1 G & H ✓

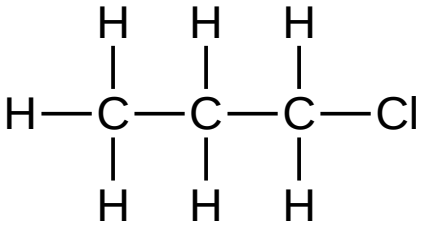
OR/*OF*



and butane */en butaan* (1)

2.7.2 I & J ✓

OR/*OF*



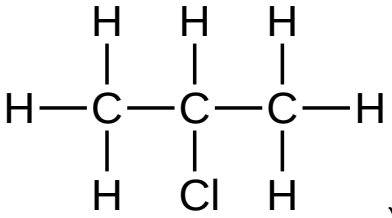
and 2-chloropropane / *en 2-chloropropaan* (1)

2.8.1 Methyl✓propane ✓ / *metiel✓propaan*

Accept/*Aanvaar*: 2-methylpropane/ *2-metielpropaan* (2)

2.8.2 1-chloro✓propane ✓ / *1-chloro✓propaan* (2)

2.9



✓✓

Marking criteria/*Nasienriglyne*:

- Whole structure correct 2/2
- If a bond/hydrogen atom is missing 1/2
- Only correct functional group but not in correct place 1/2

- *Volledige struktuur korrek 2/2*
- *Indien binding/waterstofatoom uitgelaat is 1/2*
- *Slegs funksionele groep korrek, maar in verkeerde posisie 1/2*

(2)

[25]

QUESTION/*VRAAG* 3

3.1.1 London forces/induced dipole forces/dispersion forces ✓
London-kragte/geïnduseerde dipool kragte/dispersie kragte (1)

3.1.2 London force/ dispersion forces /induced dipole forces ✓ and dipole dipole forces ✓

London-kragte/ dispersie kragte/geïnduseerde dipool kragte en dipool-dipool kragte (2)

3.2 The stronger the intermolecular forces, the higher the boiling point. ✓
OR
The weaker the intermolecular forces, the lower the boiling point.

Hoe sterker die intermolekulêre kragte, hoe hoër die kookpunt.
OF
Hoe swakker die intermolekulêre kragte, hoe laer die kookpunt. (1)

3.3.1 Ethanal ✓ / *Etanal* (1)

Negative marking from 3.3.1 to 3.3.2

3.3.2
- The type of intermolecular forces are London forces and dipole-dipole forces. ✓
- The chain length/ molecular mass/surface area increases from ethanal to pentanal. ✓
- The longer the chain length/increase in molecular mass/larger surface area the stronger the intermolecular forces. ✓
- More energy is required to overcome the stronger intermolecular forces in pentanal than in ethanal. ✓
  OR
  Less energy is required to overcome the weaker intermolecular forces in ethanal than in pentanal.
  OR
  The stronger the intermolecular force the lower the vapour pressure.
  OR
  The weaker the intermolecular force the higher the vapour pressure.

OR

- The type of intermolecular forces are London forces and dipole-dipole forces.
- The chain length/ molecular mass/surface area decreases from pentanal to ethanal.
- The shorter the chain length/decrease in molecular mass/smaller surface area the weaker the intermolecular forces.
- Less energy is required to overcome the weaker intermolecular forces in ethanal than in pentanal.

(4)

OR

- More energy is required to overcome the stronger intermolecular forces in pentanal than in ethanal.

OR

- The weaker the intermolecular force the higher the vapour pressure.

OR

- The stronger the intermolecular force the lower the vapour pressure.

Negatiewe nasien van 3.3.1 na 3.3.2

- *Die tipe intermolekulêre kragte is London-kragte en dipool-dipool kragte.*
- *Die kettinglengte/ molekulêre massa/oppervlak area verhoog van etanal na pentanal.*
- *Hoe langer die kettinglengte / verhoging in molekulêre massa/groter oppervlak area, hoe sterker die intermolekulêre kragte.*
- *Meer energie is nodig om die sterker intermolekulêre kragte te oorkom in pentanal as in etanal.*
  OF
  Minder energie is nodig om die swakker intermolekulêre kragte in etanal as in pentanal te oorkom.
  OF
  Hoe sterker die intermolekulêre kragte hoe laer is die dampdruk.
  OF
  Hoe swakker die intermolekulêre kragte hoe hoër is die dampdruk.

OF

- *Die tipe intermolekulêre kragte is London-kragte en dipool-dipool kragte.*
- *Die kettinglengte/ molekulêre massa/oppervlak area verminder van pentanal na etanal.*
- *Hoe korter die kettinglengte / vermindering in molekulêre massa/kleiner oppervlak area, hoe swakker die intermolekulêre kragte.*
- *Minder energie is nodig om die swakker intermolekulêre kragte te oorkom in etanal as in pentanal.*

OF

- *Meer energie is nodig om die sterker intermolekulêre kragte in pentanal as in etanal te oorkom.*

OF

- *Hoe swakker die intermolekulêre kragte hoe hoër is die dampdruk.*

OF

- *Hoe sterker die intermolekulêre kragte hoe laer is die dampdruk.*

3.4.1 Monomer is a small organic molecule ✓ that can be covalently bonded to each other in a repeating pattern. ✓
Accept: Monomer is a basic structural unit from which a polymer (macromolecule) is made.

Monomeer is 'n klein organiese molekule wat kovalent aan mekaar gebind is in 'n herhalende patroon. (2)
Aanvaar: *Monomeer is 'n basiese strukturele eenheid waarvan 'n polimeer (makromolekule) gemaak is.*

3.4.2 Polythene ✓(Polyethylene) / *Politeen (polietileen*) (1)
[12]

QUESTION/*VRAAG* 4

4.1.1 Bromine/*Broom* (gas)/ $Br_2(g)$ ✓ (1)

4.1.2 Addition (reaction) ✓ / *Addisie(reaksie)* (1)

4.1.3 Halogenation ✓/Bromination / *Halogenering* / *Brominering* (1)

4.1.4 1,2-dibromoethane ✓ / *1,2-dibromoetaan* ✓ (2)

4.2 B ✓ (1)

4.3.1 Hydrolysis ✓ / *hidrolise* (1)

4.3.2 Mild heat ✓
OR
Dilute strong base/KOH/NaOH
OR
(Haloalkane is dissolved in) ethanol

Matige hitte
OF
*Verdunde sterk basis/*KOH/NaOH
OF
(Haloalkane is opgelos in) ethanol (1)
[8]

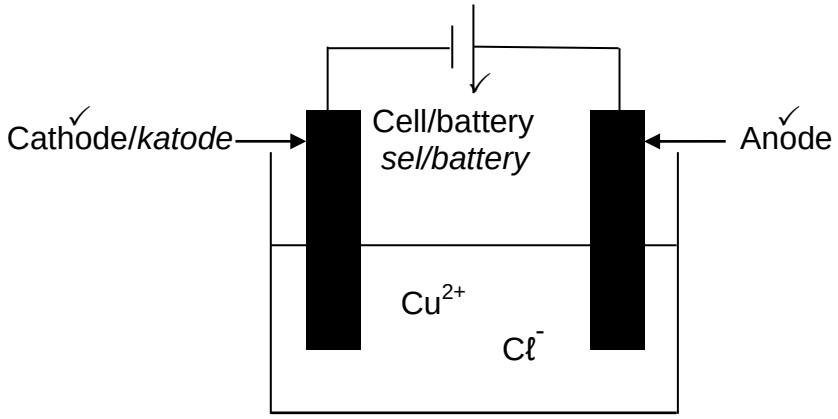
QUESTION/*VRAAG* 5

5.1 Cell/Battery/Power Source✓ / *Sel/battery/kragbron* (1)

5.2 It is a source of electrical energy ✓ to run a non spontaneuos reaction ✓
OR
The power source/battery/ cell provides the energy needed for the reaction to occur.

Dit is 'n bron van elektriese energie om 'n nie-spontane reaksie te laat plaasvind.
OF
Die kragbron/battery/sel verskaf die energie wat nodig is om die reaksie te laat plaasvind. (2)

5.3



Marking criteria/*Nasienriglyne*:	**MARKS/ *PUNTE***
• Correct symbol and position of the cell/battery/power source • *Korrekte simbool en posisie van die sel/battery/kragbron*	✓
• Anode labelled and connected to positive terminal of the cell/battery **OR** If power source is used credit the labelling of the anode. • *Anode benoem en verbind aan die positiewe terminaal van die sel/battery.* ***OF*** • *Indien 'n kragbron gebruik is krediteer die benoemde anode.*	✓
• Cathode labelled and connected to negative terminal of the cell/battery. **OR** If power source is used credit the labelling of the cathode. • *Katode benoem en verbind aan die negtaive terminaal van die sel/battery.* • ***OF*** *Indien 'n kragbron gebruik is krediteer die benoemde katode.*	✓

(3)

5.4 $CuC\ell_2$ ✓ (1)

5.5.1 Cathode: reduction (half reaction) ✓
Anode: oxidation (half reaction) ✓

Katode: reduksie- (halfreaksie)
Anode: oksidasie- (halfreaksie) (2)

5.5.2 Cathode is the negative (electrode) ✓
Anode is the positive (electrode) ✓

Katode: is die negatiewe (elektrode)
Anode is die positiewe (elektrode) (2)

5.6 $Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$ ✓✓

Marking criteria/*Nasienriglyne*:
$Cu \leftarrow Cu^{2+}(aq) + 2e^-$ ($^2/_2$) $Cu^{2+}(aq) + 2e^- \rightleftharpoons Cu(s)$ ($^1/_2$)
$Cu \rightleftharpoons Cu^{2+}(aq) + 2e^-$ ($^0/_2$) $Cu^{2+}(aq) + 2e^- \leftarrow Cu(s)$ ($^0/_2$)

NB: Don't penalise if phases are omitted
Moenie penalisiseer indien fases uitgelaat is nie. (2)

5.7 $2C\ell^-(aq) + Cu^{2+}(aq)$ ✓ $\rightarrow C\ell_2(g) + Cu(s)$ ✓ Balancing ✓ / *Balansering*

Accept/*Aanvaar*: $CuC\ell_2(aq) \rightarrow C\ell_2(g) + Cu(s)$ (3)
[16]

QUESTION/*VRAAG* 6

6.1 Spontaneous ✓ / *Spontane* (1)

6.2.1 (Electrochemical cell) that converts chemical to electrical energy.✓✓

('n Elektrochemiese sel) wat chemiese na elektriese energie omskakel. (2)

6.2.2 A substance of which the aqueous solution contains ions. ✓✓
OR
A substance that dissolves in water to give a solution that conducts electricity.

'n Verbinding waarvan die waterige oplossing ione bevat.
OF
'n Verbinding wat in water oplos, vorm oplossing wat elektrisiteit gelei. (2)

6.3 Chemical to electrical ✓✓ / *Chemiese na elektriese* (2)

6.4 Ag /Silver (electrode) ✓ / *Ag/silwer (elektrode)* (1)

Positive marking from 6.4 to 6.7/*Positiewe nasien van 6.4 tot 6.7*

6.5 $Ag^+ + e^- \rightarrow Ag$ ✓✓ (2)

Marking criteria/*Nasienriglyne*:

$Ag \leftarrow Ag^+(aq) + e^-$ ($^2/_2$) $Ag^+(aq) + e^- \rightleftharpoons Ag(s)$ ($^1/_2$)

$Ag \rightleftharpoons Ag^+(aq) + e^-$ ($^0/_2$) $Ag^+(aq) + e^- \leftarrow Ag(s)$ ($^0/_2$)

6.6

OPTION 1/*OPSIE* 1	**OPTION 2/*OPSIE* 2**
$E^\theta_{cell} = E^\theta_{cathode} - E^\theta_{anode}$ ✓ $E^\theta_{sel} = E^\theta_{katode} - E^\theta_{anode}$ $= 0,80$ ✓ $- (-0,27)$ ✓ $= 1,07$ V ✓	$Ag^+ + e^- \rightarrow Ag$ $+0,80$ ✓ $Ni \rightarrow Ni^{2+} + 2e^-$ $- (-0,27)$ ✓ $2Ag^+ + Ni \rightarrow 2Ag + Ni^{2+}$ ✓ $1,07$ V ✓

(4)

NB: Penalise if unconventional formula is used.
Penaliseer indien onkonvensionele formule gebruik word.

6.7 Ni(s)/Ni^{2+}(aq)(1 mol·dm^{-3})//Ag^+(aq)(1 mol·dm^{-3})/Ag(s)(298 K/25 °C)
✓ ✓ ✓

NB: Don't penalise if phases and standard conditions are omitted
Moenie penaliseer indien fases/standaardtoestande uitgelaat is nie. (3)

6.8.1 Biodiesel ✓
Fuel Cells / *Brandstofselle*
Wave (energy) / *golf(energie)*
Wind (energy) / *wind(energie*)
Nuclear (energy)/*Kern(energie*) ANY ONE / *ENIGE EEN* (1)

6.8.2 Pump water from underground ✓/ P*omp water uit boorgate.*
Light up at night ✓ / *Verligting snags*
Activate switches ✓ / *Aktiveer skakelaars*
Charge batteries / *Laai batterye*
Supply electric utility grid / *Voorsien elektrisiteitsnetwerk van elektriese energie.* ANY THREE / *ENIGE DRIE* (3)

[21]

QUESTION/*VRAAG* 7

7.1.1 Flat/plane mirror ✓ / *plat spieël* (1)

7.1.2 Reflection ✓ (of light) / *weerkaatsing* (*refleksie) (van lig)* (1)

7.1.3
- Angle of incidence must be equal to angle of reflection. ✓
- The normal, incident and reflected rays must lie in the same plane. ✓

- *Die invalshoek is gelyk aan die weerkaatsingshoek.*
- *Die invalshoek, normaal en die weerkaatsingshoek lê almal in dieselfde vlak.* (2)

7.1.4
- (The image) is always the same distance behind the mirror as the object is in front of the mirror. ✓
- (The image) is upright. ✓
- (The image) is virtual ✓
- (The image) is laterally/parity inverted. (The image is left-right reversed).
- (The image) is the <u>same size as the object</u>.

- *(Die beeld) is altyd dieselfde afstand agter die spieël as die beeld voor die spieël is.*
- *(Die beeld) is regop.*
- *(Die beeld) is 'n skynbeeld*
- *(Die beeld) is lateraal/sydelings (links-regs) omgekeerd.*
- *(Die beeld) is <u>dieselfde grootte as die voorwerp</u>.*

(ANY 3 / *ENIGE 3*) (3)

7.2.1 Object ✓ / *Voorwerp* (1)

7.2.2 Eye of the observer ✓ / *Oog van die waarnemer* (1)

7.2.3 Image ✓ / *Beeld* (1)

7.3.1 These distances are equal. ✓ / *Die afstande is dieselfde.* (1)

7.3.2 Remains the same. ✓ / *Bly dieselfde* (1)

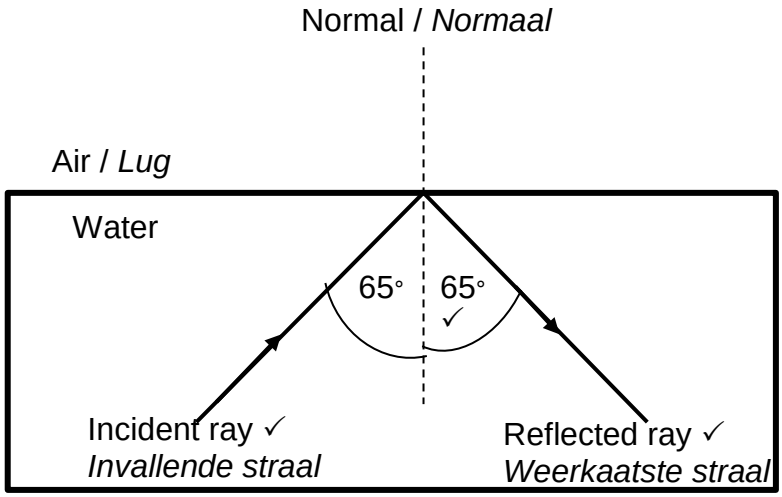
[12]

QUESTION/*VRAAG* 8

8.1.1 The ray moves along the surface between the two boundaries. ✓

Die straal beweeg al langs die oppervlak tussen die twee grense/skeidings. (1)

8.1.2



Marking criteria/*Nasienriglyne*:	**Marks**
Correct label and direction of incident ray. *Korrekte benoeming en rigting van die invallende straal*	1
Correct label and direction of reflected ray. *Korrekte benoeming en rigting van die weerkaatste straal.*	1
Magnitude of incident angle and reflected angle correctly indicated on diagram, both equal to 65° *Grootte van die invalshoek en die weerkaatsingshoek korrek aangetoon op diagram, beide gelyk aan 65°*	1

(3)

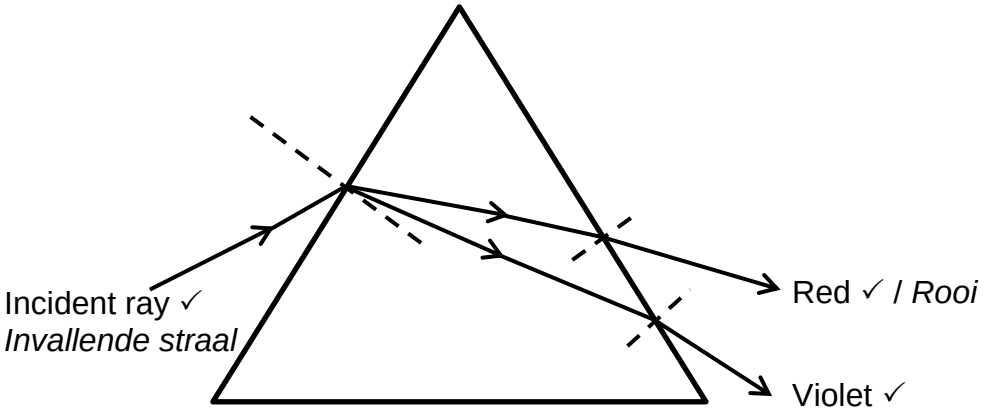
Note: If direction is not indicated on both rays, penalise only once.
Nota: Indien rigting in beide strale nie aangetoon nie, penaliseer slegs eenmalig.

8.1.3 Total internal reflection ✓ / *Totale interne weerkaatsing* (1)

8.2.1 The phenomenon whereby white light breaks up (spread out) ✓ into its component colours .✓

Die fenomeen waar witlig opbreek (uitsprei) in sy verskillende komponent kleure. (2)

8.2.2



Marking criteria/Nasienriglyne:	**Marks**
Violet light correctly labelled and positioned. *Violet lig korrek benoem en geposisioneer.*	1
Red light correctly labelled and positioned. *Rooilig korrek benoem en geposisioneer.*	1
Incident ray correctly labelled and entering the prism. *Invallende straal korrek benoem en beweeg in prisma in.* **Accept**: white light, as the incident ray ***Aanvaar**: witlig, in plaas van invallende straal*	1
All rays are refracted correctly at the normal. *Alle strale korrek gebreek/gerefrakteer by die normaal.*	1

NB:
- Penalise ONCE if arrows are not included.
- *Penaliseer EENMALIG indien pyle nie ingesluit is nie.*

(4)

8.2.3 5 (five) ✓ / *vyf* (1)

8.2.4 The <u>bending of light</u> ✓<u>when it passes from one medium to</u> <u>another</u> (of different optical density). ✓
Die <u>breking van lig</u> <u>wanneer dit van een medium na 'n ander beweeg</u> (met 'n verskillende optiese digtheid). (2)

8.2.5
- White light consists of colours of different wavelengths. ✓
- The speed of waves decreases/changes when it enters the prism. ✓
  OR
  The speed of waves increases/changes when it leaves the prism.
- The light waves with shorter wavelengths are refracted more than waves with longer wavelengths (so there will be a separation into different colours). ✓

(3)

- *Witlig bestaan uit kleure van verskillende golflengtes.*
- *Die spoed van die golwe verminder/verander wanneer dit die prisma binnegaan.*
  OF
  Die spoed van die golwe vermeerder/verander wanneer dit die prisma
  verlaat.
- *Die liggolwe met korter golflengtes word meer gebreek as die liggolwe met langer golflengtes (sodoende is daar skeiding van kleure).*

[17]

QUESTION/*VRAAG* 9

9.1

Convex/*Konvekse* lens (Converging lens/ *konvergerende lens)*	**Concave/*Konkawe* lens** (Diverging lens/d*ivergerende lens*)	**Marks/ *Punte***
The lens is thicker in the middle than at the edges. **OR** Surfaces bulge outwards in the centre. *Die lens is dikker in die middel as by die punte.* ***OF*** *Die oppervlaktes bult uitwaarts in die senter/middel.*	The lens is thinner in the middle than at the edges. **OR** The outer surfaces curve inward. *Die lens is dunner in die middel as by die punte.* ***OF*** *Die oppervlaktes buig inwaarts in die senter/middel.*	✓✓
Parallel light rays passing through it bend inward and meet (converge) at the focal point. *Parallelle ligstrale wat deur die lens beweeg, buig inwaarts en ontmoet (konvergeer) by die fokuspunt.*	Parallel light rays passing through it bend outwards or diverge. *Parallelle ligstrale wat deur die lens beweeg, buig uitwaarts en divergeer.*	✓✓
Corrects farsightedness/hyperopia (hypermetropia). *Korrigeer versiendheid/hiperopie.*	Corrects shortsightedness/myopia. *Korrigeer bysiendheid/miopie*	

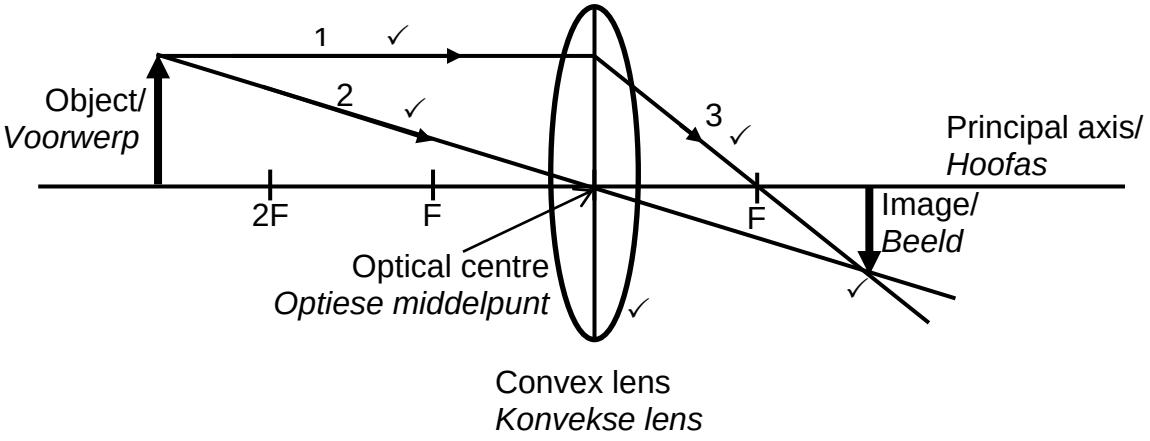
NB: Credit 2 marks if the comparison correlates with each other.
Krediteer 2 punte indien die vergelyking met mekaar korreleer. (4)

9.2.1 Far-sightedness/hyperopia(hypermetropia) ✓.

Versiendheid/hiperopie. (1)

9.2.2 Convex lens ✓ / *Konvekse lens* (1)

9.3



Marking criteria/*Nasienriglyne*:	**Marks/*Punte***
Ray 1 starts at the head of the object and moves parallel to the principal axis. ***Straal 1*** *begin aan bokant van voorwerp en beweeg parallel aan die hoofas.*	1
Ray 2 starts at the head of the object and passes through the optical centre without changing direction. ***Straal 2*** *begin aan bokant van voorwerp en beweeg deur die optiese middelpunt sonder om van rigting te verander.*	1
Ray 3 deflects from ray 1 on the other side of the lens and passes through **F**. ***Straal 3*** *buig afwaarts vanaf straal 1 aan die anderkant van die lens en beweeg deur* ***F****.*	1
Convex lens is used. *Konvekse lens word gebruik.*	1
Both **ray 2** and **3** intersect at the head of the inverted image. *Beide* ***straal 2*** *en* ***3*** *sny by die kop van omgekeerde beeld.*	1

(5)
[11]

NB: Penalise ONCE if arrows are not included.
Penaliseer EENMALIG indien pyle nie ingesluit is nie.

QUESTION/*VRAAG* 10

10.1 Electromagnetic waves are changing magnetic and electric fields mutually perpendicular to each other ✓ and the direction of propagation of the waves. ✓

Elektromagnetiese golwe is wisselende magnetiese en elektriese velde wat loodreg tot mekaar is en tot die voortplantingsrigting van die golwe. (2)

10.2.1 Radio (waves) ✓/ *Radio(golwe)*. (1)

10.2.2 Gamma (rays) ✓/ *Gamma(strale).* (1)

10.3 $E = hf$ ✓

$= (6{,}63 \times 10^{-34})(7{,}50 \times 10^{14})$ ✓

$= 4{,}97 \times 10^{-19}$J ✓

Apply negative marking.

Therefore the energy of the photon is more than the energy of a photon of blue light.
Therefore it is a photon of indigo light.✓

Pas negatiewe nasien toe.

Die energie van die foton is meer as die energie van 'n foton van blou lig.
Dus is dit 'n foton van indigo lig. (4)
[8]

TOTAL/*TOTAAL:* 150