

Geometrische Optika Memo
November 2018/1

1.5 B ✓✓

(2)

1.6 D ✓✓

(2)

QUESTION 7/VRAAG 7

7.1 Refraction/Refraksie ✓

(1)

7.2

<p>OPTION 1/OPSIE 1 $n_i \sin \theta_i = n_r \sin \theta_r$ ✓ $1 \sin \theta_i = 1,33 \sin 40^\circ$ ✓ $\theta_i = 58,75^\circ$</p>	<p>OPTION 2/OPSIE 2 $n = \frac{\sin \theta_i}{\sin \theta_r}$ ✓ $1,33 = \frac{\sin \theta_i}{\sin 40^\circ}$ ✓ $\sin \theta_i = 1,33 \sin 40^\circ$ $\theta_i = 58,75^\circ$</p>
<p>Therefore the angle between ray and surface/Daarom is die hoek tussen invallende straal en oppervlak $\theta = 90^\circ - 58,75^\circ$ ✓ $= 31,25^\circ$ ✓</p>	

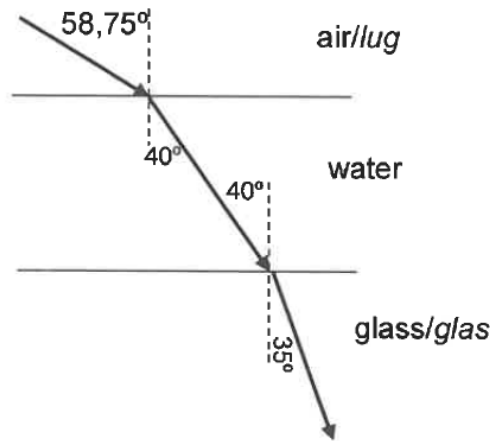
(4)

7.3

$n_i \sin \theta_i = n_r \sin \theta_r$
 $1,33 \sin 40^\circ$ ✓ $= n_r \sin 35^\circ$ ✓
 $n_r = 1,49$ ✓

(3)

7.4



2018 -11- 12
 APPROVED MARKING GUIDELINE
 PUBLIC EXAMINATION
 PRIVATE BAG X895, PRETORIA 0001

Allocation of marks/Toekenning van punte:

(5)

Light ray bends towards normal in water <i>Ligstraal breek na die normaal in water</i>	✓
Light ray bends further towards normal in glass <i>Ligstraal breek nog meer na die normaal in glas</i>	✓
Angle of incidence 58,75° shown (OR 31,25°) <i>Invalshoek 58,75° aangedui (OF 31,25°)</i>	✓
Angles in water (40°) <i>Hoeke in water (40°)</i>	✓
Angle in glass (35°) <i>Hoeke in glas (35°)</i>	✓
If normal lines are not indicated, penalise with one mark <i>Indien normaal lyne nie aangedui is nie, penaliseer met een punt</i>	
If arrows are omitted, penalise -1 (maximum 4/5) <i>Indien pylpunte weggelaat word, penaliseer -1 (maks 4/5)</i>	

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7.5

$$n = \frac{c}{v} \quad \checkmark$$

$$1,5 = \frac{3 \times 10^8}{v} \quad \checkmark$$

$$v = 2 \times 10^8 \text{ m} \cdot \text{s}^{-1} \quad \checkmark$$

(3)

7.6

No/Neen \checkmark

(1)

[17]

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1.5 B ✓✓

(2)

1.6 C ✓✓

(2)

QUESTION/VRAAG 6

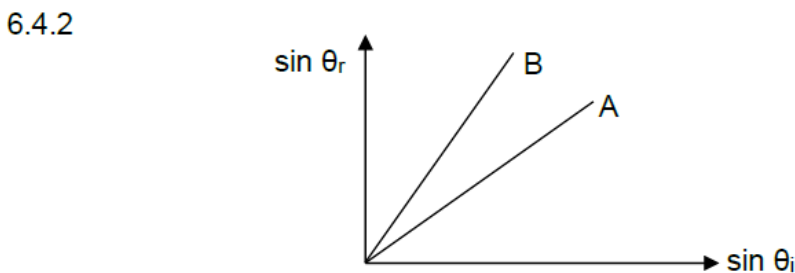
- 6.1 Angle of incidence is the angle between the normal to a reflecting surface and incident ray. ✓✓
Invalshoek is die hoek tussen die normaal op die oppervlak en die invallende straal. ✓✓ (2)

<p>6.2</p> <p>OPTION 1/OPSIE 1</p> $\text{gradient} = \frac{0,37 - 0}{0,56 - 0} = 0,66 \checkmark$ $\text{gradient} = \frac{\sin \theta_r}{\sin \theta_i} = \frac{n_i}{n_r}$ $\text{gradient} = \frac{1}{n_r}$ $n_r = \frac{1}{0,66} \checkmark$ $n_r = 1,51 \checkmark$	<p>OPTION 2/OPSIE 2</p> $n_i \sin \theta_i = n_r \sin \theta_r \checkmark$ $1(0,56) = n_r (0,37) \checkmark$ $n_r = 1,51 \checkmark$
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(3)

- 6.3 **POSITIVE MARKING FROM QUESTION 6.2**
POSITIEWE NASIEN VANAF VRAAG 6.2
- $$n = \frac{c}{v} \checkmark$$
- $$1,51 = \frac{3 \times 10^8}{v} \checkmark$$
- $$v = 1,99 \times 10^8 \text{ m}\cdot\text{s}^{-1} \checkmark$$
- (3)

- 6.4.1 $n_i \sin \theta_i = n_r \sin \theta_r \checkmark$
 $1 \sin 40^\circ \checkmark = n_r \sin 31^\circ \checkmark$
 $n_r = 1,25 \checkmark$ (4)



Criteria/Kriteria:
 The gradient of B must be bigger than the gradient of A. ✓✓
Die helling van B moet groter wees as die helling van A. ✓✓ (2)

- 6.5.1 Angle of incidence should be between 49° and 90°. ✓✓
Invalshoeke tussen 49° en 90°. ✓✓
OR/OF
 $49^\circ < \theta < 90^\circ$. (2)

- 6.5.2 Light must travel from optically denser medium (higher refractive index) to an optically less dense medium (lower refractive index). ✓✓
Lig moet beweeg vanaf 'n medium met hoë optiese digtheid (hoë brekingsindeks) na 'n medium met lae optiese digtheid (lae brekingsindeks) ✓✓ (2)

1.8 D ✓✓ (2)

QUESTION/VRAAG 6

6.1 To identify the unknown material. ✓✓ / Om die onbekende stof te identifiseer. (2)

6.2.1 Angle of incidence ✓ / Invalshoek (1)

6.2.2 Angle of refraction ✓ / Brekingshoek (1)

6.3.1 $n_1 \sin \theta_1 = n_2 \sin \theta_2$ ✓
 $n_2 = \frac{1 \sin 5^\circ}{\sin 3,76^\circ}$ ✓
 $= 1,33$ ✓

Note/Aantekeninge:

- Any set in TABLE 6.1 can be used./
Enige stel kan in TABEL 6.1 gebruik word.
- Answer range/Antwoord reikwydte (0,97-1,37)

(4)

6.3.2 Water: liquid ✓ / Water: vloeistof

Note/Aantekeninge:

- Take answer of QUESTION 6.3.1 and compare it to the closest values in TABLE 6.2. in order to identify the unknown material.
Neem die antwoord van VRAAG 6.3.1 en vergelyk dit met die naaste waardes in TABEL 6.2 om die onbekende stof te identifiseer.

(1)

6.4 $n_1 \sin \theta_c = n_2 \sin 90^\circ$ ✓
 $\sin \theta_c = \frac{1 \sin 90^\circ}{1,54}$ ✓
 $\theta_c = \sin^{-1} \left(\frac{1 \sin 90^\circ}{1,54} \right)$ ✓
 $= 40,49^\circ$ ✓

(5)

[14]

1.6 B ✓✓

QUESTION/VRAAG 8

8.1 Angle of incidence/ θ_i ✓ / $\sin \theta_i$ ✓
Invalshoek/ θ_i ✓ / $\sin \theta_i$ ✓ (1)

8.2 Type of block used/Temperature of the surroundings/Source of light/Surface on which block is placed. ✓.
Tipe blok gebruik/Temperatuur van die omgewing/Bron van die lig/Oppervlak waarop blok geplaas word. ✓ (1)

8.3 Snell's law has been verified:

* The graph is a straight line through the origin, because $\sin \theta_i \propto \sin \theta_r$. ✓

* Gradient = $\frac{\sin \theta_i}{\sin \theta_r} = \text{constant}$ ✓

Snell se wet is bewys:

• *Die grafiek vorm 'n reguitlyn deur die oorsprong, omdat $\sin \theta_i \propto \sin \theta_r$.* ✓

• *Gradiënt = $\frac{\sin \theta_i}{\sin \theta_r} = \text{konstante}$ ✓* (2)

8.4 Gradient/Gradiënt = $n = \frac{\Delta \sin \theta_i}{\Delta \sin r} = \frac{0,77 - 0}{0,51 - 0} = 1,51$ ✓ (4)

[8]

Geometriese Optika Memo

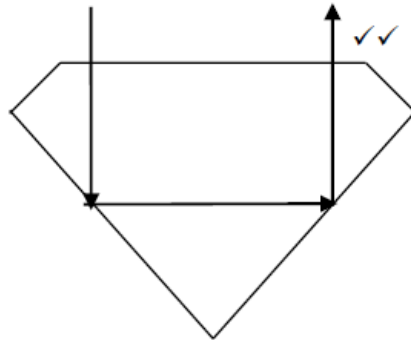
November 2015/2

QUESTION/VRAAG 9

9.1 $n \sin \theta_i = n \sin \theta_r$ ✓
 $2,42 \sin \theta_i = 1 \sin 90^\circ$ ✓
 $\theta_i = \sin^{-1} 2,42$
 $= 24,2^\circ$ ✓

(4)

9.2



No arrows: max $\frac{1}{2}$
Geen pyltjies: maks

(2)

9.3 Total internal reflection ✓ / Totale interne weerkaatsing ✓

(1)

9.4 Light moves from medium of higher optical density to medium of lower optical density. ✓

Angle of incidence must be larger than critical angle. ✓

Lig beweeg van medium van hoër optiese digtheid na medium met laer optiese digtheid. ✓

Invalshoek moet groter wees as kritiese hoek. ✓

(2)

9.5 Endoscope/Endoskoop ✓

(1)

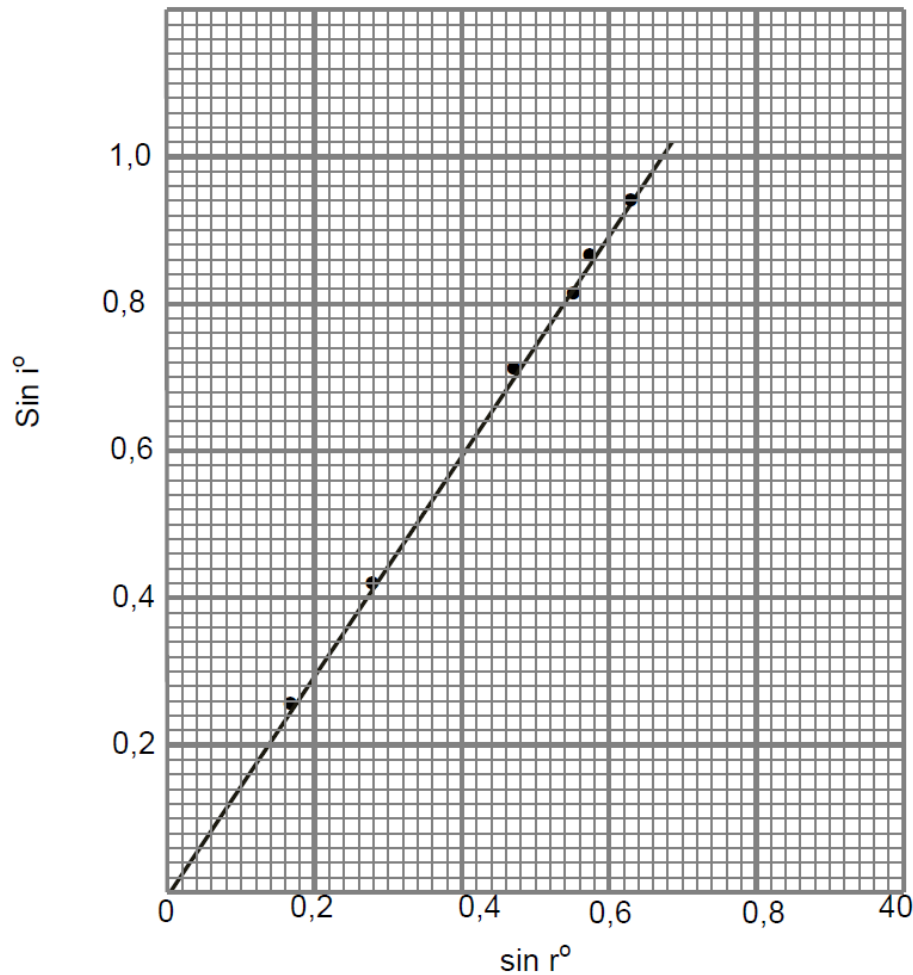
[10]

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1.5 A✓✓

(2)

Graph of $\sin i$ versus $\sin r$ / *Grafiek van $\sin i$ teenoor $\sin r$* 

$$\begin{aligned} \text{Slope of graph/Helling van grafiek} = n &= \frac{\Delta \sin i}{\Delta \sin r} \checkmark \\ &= \frac{(0,9 - 0)}{(0,6 - 0)} \checkmark \\ &= 1,5 \checkmark \end{aligned}$$

RUBRIC FOR MARKING GRAPH / RUBRIEK VIR NASIEN VAN GRAFIEK

Axes correctly chosen and labelled / <i>Asse korrek gekies en benoem</i>	✓
Graph has a <i>descriptive</i> title / <i>Grafiek het 'n beskrywende titel</i>	✓
Correctly plotted points (minimum of 4 points) / <i>Punte korrek geteken (minimum van 4 punte)</i>	✓✓
Best line of fit / <i>Beste lyn van passing</i>	✓
Deduct a maximum of 1 mark if more than 3 points are incorrectly plotted Trek 'n maksimum van 1 punt af indien meer as 3 punte verkeerd getrek is	

(8)

QUESTION 6/VRAAG 6

6.1.1 $r/\sin r$ ✓ (1)

6.1.2 $i/\sin i$ (1)

6.1.3 The type of block used/temperature of the surroundings/source of light/surface on which block is placed
Die tipe blok gebruik/temperatuur van die omgewing/bron van die lig/oppeervlak waarop blok geplaas word. (1)

6.3

$$n = \frac{c}{v} \checkmark$$

$$v = \frac{3 \times 10^8}{1,5} \checkmark$$

$$= 2 \times 10^8 \text{ m}\cdot\text{s}^{-1} \checkmark$$

(3)
[14]

QUESTION 7/VRAAG 7

7.1 The index of refraction of the incident medium multiplied by the sine of the incident angle is equal to the index of refraction of the refracting medium multiplied by the sine of the refracted angle. ✓✓
Die brekingsindeks van die invallende medium vermenigvuldig met die sinus van die invalshoek is gelyk aan die brekingsindeks van die refraktiewe medium vermenigvuldig met die sinus van die gebreekte hoek.

NOTE/LET WEL:
 Only 1 mark for
Slegs 1 punt vir
 $\frac{\sin i}{\sin r} = \text{a constant.}$
 $= \text{'n konstante}$

OR/OF
 When light passes from one medium into another, the ratio of the sine of the angle of incidence to the sine of the angle of refraction is a constant.
As lig van een medium na 'n ander beweeg, is die verhouding van die sinus van die invalshoek tot die sinus van die brekingshoek 'n konstante.

(2)

7.2

$$\sin c = \frac{1}{n} \checkmark$$

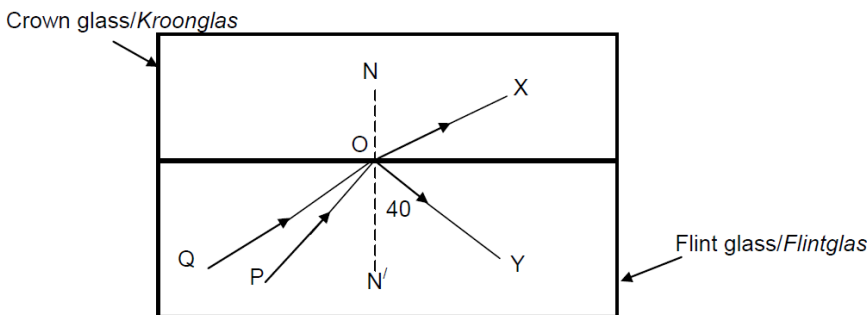
$$= \frac{1}{1,66} \checkmark$$

$$c = 37,04^\circ \checkmark$$

(3)

7.3
&7.4

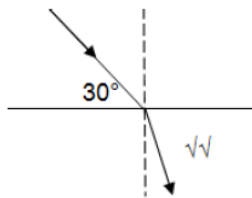
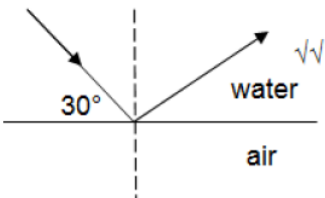
(1)
(2)



7.5 Greater than/Groter as✓

(1)
[9]

QUESTION/VRAAG 7

7.1	7.1.1	$n_1 \sin \theta_1 = n_2 \sin \theta_2 \checkmark$ $1,00 \times \sin 47^\circ \checkmark = 1,33 \sin \theta_2 \checkmark$ $\sin \theta_2 = 0,55 \checkmark$ $\theta_2 = 33,36^\circ \checkmark$	(4)
	7.1.2	$n_1 \sin \theta_1 = n_2 \sin \theta_2$ $1,33 \sin 47^\circ \checkmark = 1,00 \sin \theta_2 \checkmark$ $\theta_2 = 76,58^\circ \checkmark$	(3)
7.2	$n = \frac{c}{v} \checkmark$ $1,33 = \frac{3 \times 10^8}{v} \checkmark$ $v = 2,26 \times 10^8 \text{ m.s}^{-1} \checkmark$		(3)
7.3	$n_1 \sin \theta_1 = n_2 \sin \theta_2$ $1,33 \sin \theta_1 \checkmark = 1,00 \sin 90^\circ \checkmark$		(2)
7.4	7.4.1		7.4.2
		(2)	
7.5	(any of the following/enige van die volgende) -telecommunications/telekommunikasie \checkmark -video communications/videokommunikasie -computer-data communications/rekenaardatakommunikasie -medicine - endoscope)/medisyne - endoskoop		(1)

Geometriese Optika Memo

Modelvraestel 2013/1

1.6 B ✓✓ (2)

QUESTION 7/VRAAG 7

7.1 The ratio of $\sin i$ to $\sin r$ is constant. ✓✓
Die verhouding van $\sin i$ tot $\sin r$ is konstant. (2)

7.2 1,4,2,3,6,5 ✓✓ (2 or/of 0) (2)

7.3 To ensure that the position of the glass block remains the same/glass block does not shift. ✓
Om te verseker dat die posisie van die glasblok dieselfde bly/die glasblok nie skuif nie. (1)

Geometriese Optika Memo

Modelvraestel 2013/2

$$\begin{aligned} 7.4 \\ 7.4.1 \quad \text{Gradient/Gradiënt} &= \frac{\Delta \sin i}{\Delta \sin r} \checkmark \\ &= \frac{0,6 - 0}{0,4 - 0} \checkmark \\ &= 1,5 \checkmark \end{aligned}$$

Note/Let Wel

Accept values from/aanvaar waardes vanaf 1,44 to/tot 1,5.

(4)

7.4.2 The refractive index of glass ✓
Die brekingsindeks van glas.

(1)
[10]

QUESTION 8/VRAAG 8

$$\begin{aligned} 8.1 \quad n_1 \sin \theta_1 &= n_2 \sin \theta_2 \checkmark \\ (1,44) \sin 30^\circ &= (1) \sin \theta_2 \checkmark \\ \theta_a &= 46,05^\circ \checkmark \end{aligned}$$

(4)

8.2 The glass block is optically more dense than air. ✓
When light passes from an optically dense into an optically less dense medium, it bends away from the normal. ✓
Die glasblok is opties digter as lug.
Wanneer lig van 'n optiese digter medium na 'n opties minder digte medium beweeg, buig dit weg van die normaal af.

(2)

8.3 Increases/Neem toe ✓

(1)

8.4 The angle of incidence in the optically denser medium for which the angle of refraction in the optically less medium is 90° . ✓✓
Die invalshoek in die opties digter medium waarvoor die brekingshoek in die opties minder digte medium 90° is.

OR/OF

The angle of incidence in the optically denser medium beyond which the light/wave will be totally internally reflected. ✓✓
Die invalshoek in die opties digter medium waarbo die lig/golf totale interne weerkaatsing ondervind.

(2)

8.5 Total internal reflection/Totale interne weerkaatsing ✓

(1)

8.6 Optical fibres for communication/in endoscopes. ✓
Optiese vesels vir kommunikasie/in endoskope. ✓

OR/OF

Binoculars/Verkykers

OR/OF

Periscopes/Periskope

(1)

[11]