

FIZIK

TINGKATAN 4

SIR JESU

PHYSICS FORM 4			
CHAPTER	TOPIC	DATE	REMARKS
1	PENGUKURAN / MEASUREMENT		
2	DAYA DAN GERAKAN / FORCE AND MOTION		
3	KEGRAVITIAN / GRAVITATION		
4	HABA / HEAT		
5	GELOMBANG / WAVES		
6	CAHAYA DAN OPTIK / LIGHT AND OPTICS		

LESSON 3: TOTAL INTERNAL REFLECTION

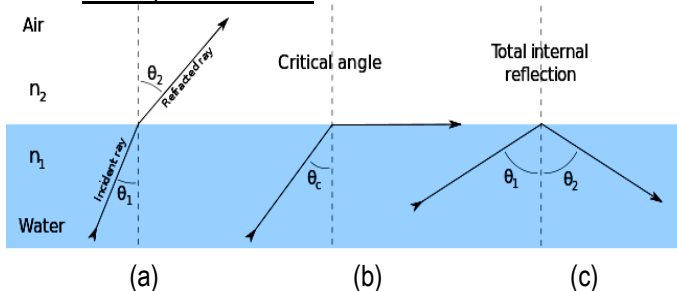
Pantulan dalam penuh

The total reflection happens when the angle of incidence of light ray propagating from medium of higher optical density to another medium of lower optical density exceeds a specific critical angle.

Pantulan dalam penuh berlaku bila sudut tuju bagi sinar tuju cahaya yang merambat dari medium yang ketumpatan optik lebih tinggi ke medium ketumpatan optik lebih rendah melebihi sudut genting tertentu.

Ray diagram to show how the Total Internal Reflection happen

Rajah sinar untuk menunjukkan bagaimana pantulan dalam penuh berlaku.



- (a) Angle of incidence θ_1 is small, light ray is refracted
Sudut tuju θ_1 kecil, cahaya dibiaskan
- (b) Angle of incidence equal to critical angle, θ_c . Angle of refraction is 90° and the refracted ray travels along the water-air boundary.
Sudut tuju sama dengan sudut genting. Sudut pembiasan ialah 90° dan sinar yang terbias merambat mengikut sempadan air-udara.
- (c) Angle of incidence greater than critical angle, $\theta_2 > \theta_c$. No refraction occurs. All the light is reflected within the water. Total internal reflection occurs.
Sudut tuju melebihi sudut genting, $\theta_2 > \theta_c$. Tiada pembiasan berlaku. Semua sinar cahaya dipantulkan kedalam air. Pantulan dalam penuh berlaku.

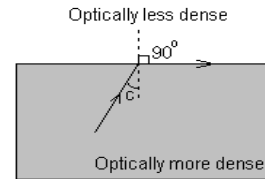
The conditions for the occurrence of total internal reflection.

Syarat-syarat untuk pantulan dalam penuh berlaku

- The light ray must be travel from an optically denser medium to optically less dense medium.
Cahaya merambat dari medium lebih ketumpatan optik lebih tinggi ke medium ketumpatan optik lebih rendah.
- The angle of incidence must be greater than the critical angle.
Sudut tuju melebihi sudut genting.

The Critical Angle / sudut genting, c

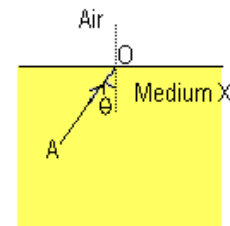
The angle of incidence when angle of refraction of 90°
Sudut tuju bila sudut pembiasan ialah 90°



$$n = \frac{\sin i}{\sin r} \\ = \frac{\sin 90^\circ}{\sin c} \\ = \frac{1}{\sin c}$$

Example 1

Figure shows a light ray AO travelling from medium X to the air. [The refractive index of medium X = 2.0]
Rajah menunjukkan sinar cahaya AO merambat dari medium X ke udara. [Indeks pembiasan medium X = 2.0]

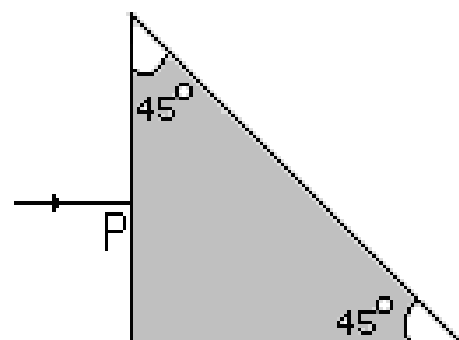


Draw the ray light after it passes through the point O when

- Lukis sinar cahaya selepas ia melalui titik O bila*
- (a) $\theta = 25^\circ$ (b) $\theta = 30^\circ$ (c) $\theta = 35^\circ$

Example 2

The diagram shows a light ray entering in a glass prism. [Refractive index of glass = 1.51]
Rajah menunjukkan sinar cahaya merambat melalui prisma kaca. [indeks pembiasan kaca = 1.51]



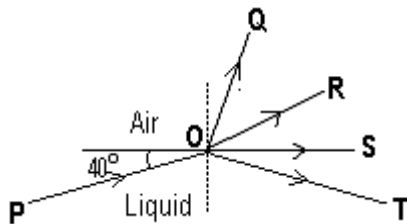
- (a) Determine the critical angle of the glass.
Hitung sudut genting kaca.

- (b) Draw the ray light after it passes through a point P until the direction of the ray of light unchanged.
Lukis sinar cahaya selepas ia melalui titik P sampai arah sinar cahaya tidak berubah.

Example 3

The figure shows a ray of light PO traveling in a liquid strikes the liquid-air boundary. [The critical angle of the liquid = 45°]

Rajah menunjukkan satu sinar cahaya PO merambat dari cecair ke sempadan cecair-udara. [sudut genting cecair = 45°]



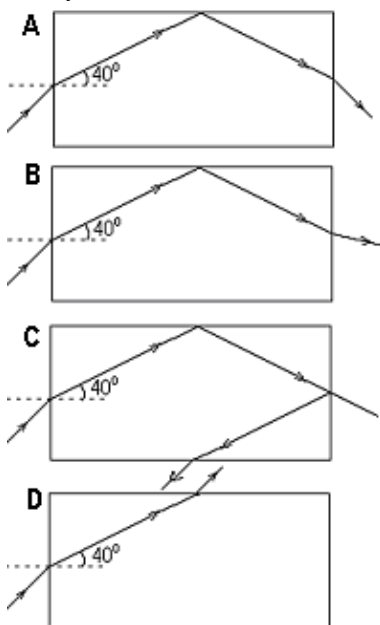
In which direction does the light move from O?
Arah manakah cahaya akan merambat dari O?
A OQ B OR C OS D OT

Example 4

A ray of light incident on one side of a rectangular glass block

If the angle of refraction in the glass block is 40° , which one of the following diagrams best represents this ray? [The critical angle of glass is 42°]

Satu sinar cahaya menuju ke arah bahagian tepi satu bungkah kaca berbentuk segiempat. Jika sudut biasan di dalam kaca adalah 40° , gambar rajah manakah paling sesuai untuk menunjukkan perambatan cahaya seterusnya?



Example 5

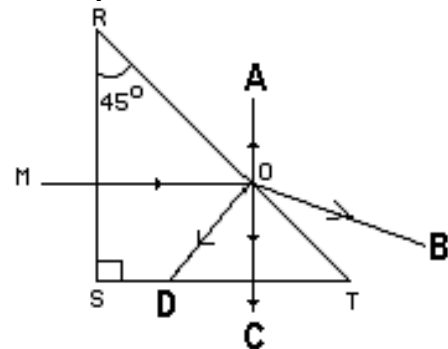
The diagram shows a light ray, P, directed into a glass block. The critical angle of the glass is 42° . In which direction does the light move from point Q?

Rajah menunjukkan satu sinar cahaya P merambat ke dalam bungkah kaca. Sudut genting kaca = 42° . Arah manakah cahaya akan merambat dari Q?

Example 6

The diagram shows a light ray, M, directed into a glass block. The critical angle of the glass is 42° . In which direction does the light move from point O?

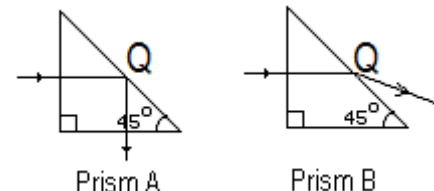
Rajah menunjukkan satu sinar cahaya M merambat ke dalam bungkah kaca. Sudut genting kaca = 42° . Arah manakah cahaya akan merambat dari O?



Example 7

The figure shows a ray of light is incident in air to the surface of Prism A and B.

Rajah menunjukkan satu sinar cahaya P merambat ke dalam prisma A dan B



Which comparison is correct?

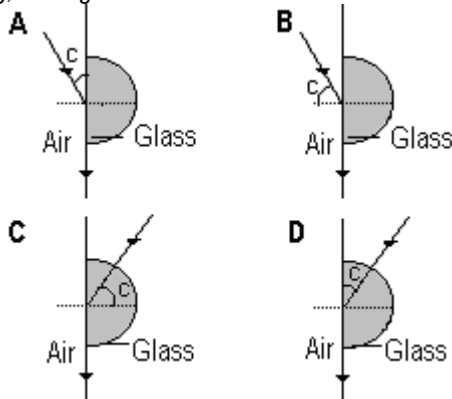
Pernyataan manakah benar?

- A Optical density of prism A < optical density of prism B
Ketumpatan optik A < ketumpatan optik B
- B Critical angle of prism A < critical angle of prism B
Sudut genting prisma A < sudut genting B
- C Refractive index of prism A < refractive index of prism B
Indeks biasan prisma A < indeks biasan B
- D Incident angle at Q for prism A > incident angle at Q of prism B
Sudut tuju di Q bagi prisma A > sudut tuju di Q prisma B

Example 8

Which of the following shows the correct critical angle, c , of the semi-circular glass block?

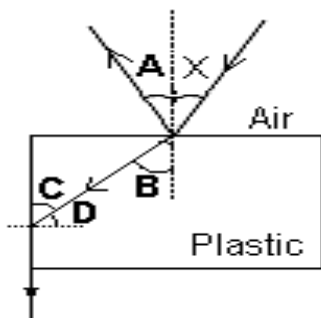
Gambarajah manakah menunjukkan dengan betul sudut genting, c bungkah kaca semi-bulatan?



Example 9

The diagram shows a light ray travelling from air into a plastic block with an angle of incidence, X . What is the critical angle of the plastic?

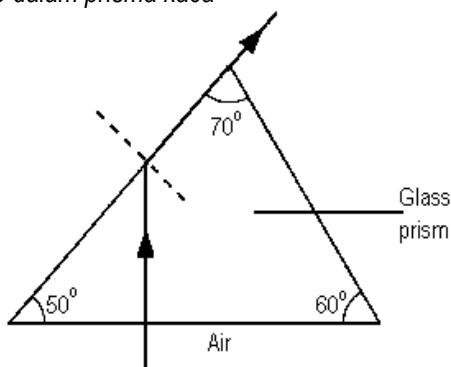
Rajah menunjukkan satu sinar cahaya P merambat dari udara ke bungkah plastic dengan sudut tuju, X . Sudut manakah mewakili sudut genting bungkah plastic?



Example 10

The diagram shows a light ray travelling from air into a glass prism.

Rajah menunjukkan satu sinar cahaya merambat dari udara ke dalam prisma kaca



What is the critical angle of the glass?

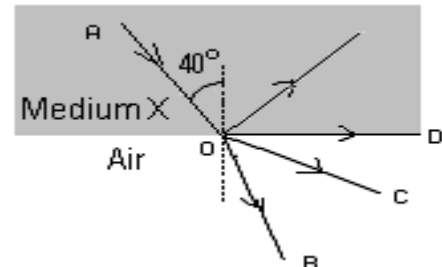
Berapakah sudut genting kaca?

A 40° B 50° C 60° D 70° E 80°

Example 11

The figure shows a ray of light AO traveling in medium X strikes the medium X -air boundary. [The refractive index of medium $X = 1.12$]

Rajah menunjukkan sinar cahaya AO merambat dari medium X ke sempadan medium-udara. Indeks biasan medium $X=1.12$

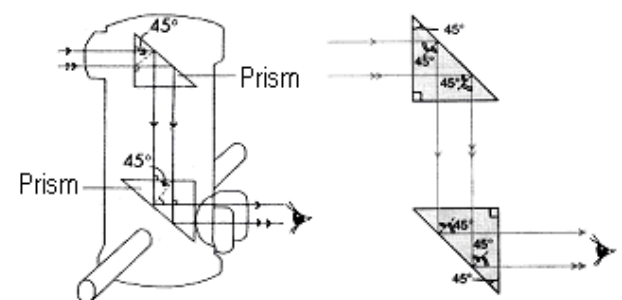


In which direction does the light move from O ?

Arah manakah cahaya akan merambat dari O ?

A OE B OD C OC D OB

Prism periscope / Periskop prisma



The periscope is built using two right-angled prisms made of glass.

Periskop dibina menggunakan dua prism kaca bersudut tegak.

The critical angle of the prism is 42° .

Sudut genting kaca ialah 42°

The angle of incidence is 45° is greater than the critical angle.

Sudut tuju ialah 45° iaitu lebih besar dari sudut genting.

Pantulan dalam penuh berlaku.

Total internal reflection occurs

The characteristics of the images are / Ciri-ciri imej adalah

(i) Virtual (ii) Upright (iii) Same size as the object.

Maya Tegak Sama saiz dengan objek

Advantages of the prism periscope compared to mirror periscope,

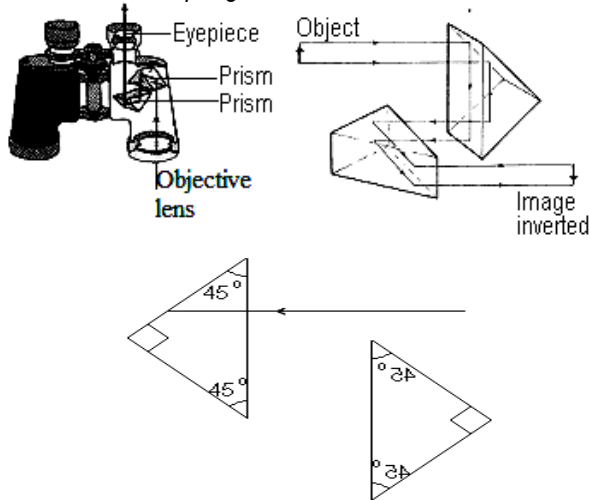
Kelebihan menggunakan prisma berbanding cermin dalam periskop

(i) The image is brighter / Imej adalah lebih cerah

(ii) No multiple images is formed (very clear)

Tiada imej yang bertindih (sangat jelas)

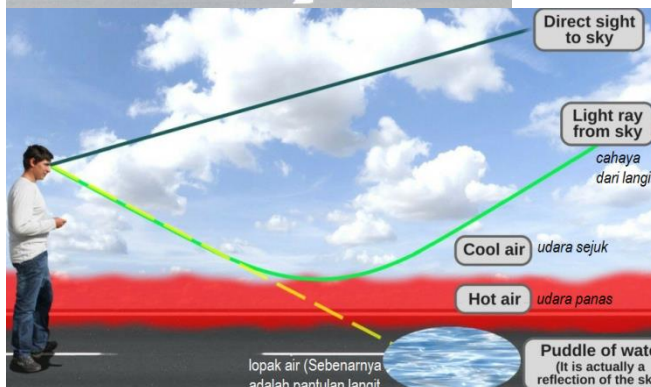
Binocular / Teropong



A ray light experiences two total internal reflections at each prism. The two prisms are to invert the image (upside down and right-to-left.) But the lenses in the binoculars also invert the image and so the prisms put it back the right way again. So the final image in binoculars is upright, not laterally inverted and magnified.

Sinar cahaya mengalami pantulan dalam penuh sebanyak dua kali dalam setiap prisma. Kedua-dua prisma itu akan menyongsangkan imej (atas ke bawah dan kiri ke kanan). Tetapi kedua-dua kanta akan menyongsangkan imej dan prisma akan menyebabkan imej kelihatan seperti objek asal. Imej akhir adalah tegak, tidak songsang sisi dan dibesarkan.

Mirages / Logamaya



In the time when the weather is hot, the incidence ray from the sun passes through a dense air layer to a less dense air layer. Finally, the ray of passes through the air layer close to the road surface at an angle of incidence greater than the critical angle.

Total internal reflection occurs at this layer. The observer sees the image of the sky on the surface of the road as a pool of water.

Pada hari yang panas, sinar cahaya dari matahari akan merambat dari lapisan udara yang berketumpatan tinggi ke lapisan udara berketumpatan rendah. Akhirnya, cahaya akan melalui lapisan udara berdekatan dengan jalan pada sudut tuju melebihi sudut genting. Pemerhati akan melihat imej maya langit pada jalan sebagai takungan air.

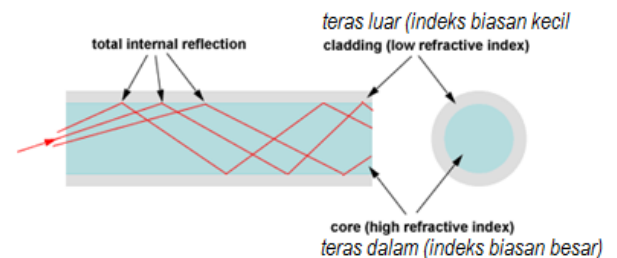
Fibre optics

The external wall of a fibre optic is less dense than the internal wall. When light rays travel from a denser internal wall to a less dense external walls at an angle that exceeds the critical angle, total internal reflection occurs.

The advantages of the fibre optics:

- (i) Cheap
- (ii) easily handled
- (iii) More information can be transmitted

Dinding dalam gentian optik adalah lebih tumpat berbanding dinding luar. Bila cahaya merambat dari dinding dalam yang lebih tumpat ke dinding luar yang kurang tumpat pada sudut tuju lebih besar dari sudut genting, pantulan dalam penuh berlaku.



TUTORIAL 3

1. Diagram 4.1 shows a light ray incident into a glass block.

Rajah 4.1 menunjukkan sinar cahaya merambat ke dalam bungkah kaca

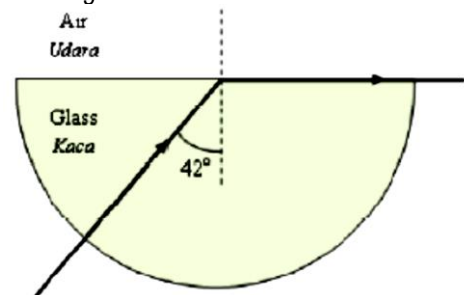


Diagram 4.1

- (a) (i) Based on Diagram 4.1, the angle of 42° is known as

Berdasarkan Rajah 4.1 sudut 42° dinamakan sebagai

.....[1 mark]

- (ii) Calculate the refractive index for the glass block.

Hitung indeks pembiasan bungkah kaca.

[2 marks]

- (b) The light ray is adjusted so that the angle at M is now 48° , as shown in Diagram 4.2.
Sinar cahaya dilaraskan supaya sudut di M adalah 48° , seperti yang ditunjukkan pada Rajah 4.2

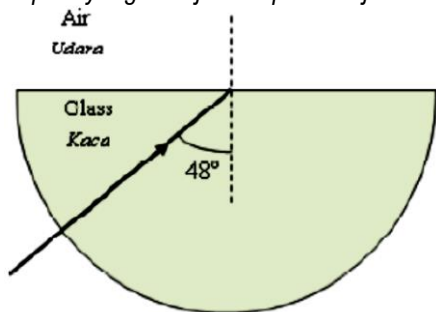


Diagram 4.2

- (i) On Diagram 4.2, complete the pathway for the light ray.

Pada Rajah 4.3, lengkapkan lintasan sinar cahaya.

[1 mark]

- (ii) Explain your answer in (b)(i).

Terangkan jawapan anda di(b)(i)

.....[1 mark]

- (c) Diagram 4.3 shows a light ray propagating into a glass block.

Rajah 4.3 menunjukkan sinar cahaya merambat ke dalam bungkah kaca.

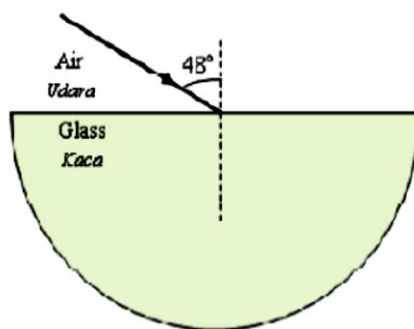


Diagram 4.3

- (i) On Diagram 4.3, complete the propagation of the light ray.

[1 mark]

Pada Rajah 4.3, lengkapkan lintasan cahaya

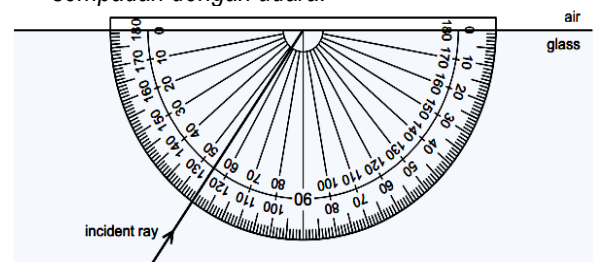
- (ii) What happens to the angle of refraction if a denser glass block is used?

Apa yang berlaku pada sudut pembiasan jika kaca yang lebih tumpat digunakan?

.....[1 mark]

- 2.(a) Fig. 6.1 shows a protractor superimposed on the path of a ray of light. The light is travelling in glass with refractive index of the glass is 1.56 towards the boundary with air.

Rajah menunjukkan sebuah protractor ditindih pada lintasan sinar cahaya. Sinar cahaya merambat didalam kaca dengan indeks biasan 1.56 ke arah sempadan dengan udara.



- (i) Use the protractor to measure the angle of incidence of

the ray of light at the boundary with the air.

Menggunakan protaktor ukur sudut tuju sinar cahaya di

sempadan dengan udara

..... [1m]

- (ii) Calculate the angle of refraction in the air.

Hitung sudut biasan sinar cahaya di udara

[2m]

- (b)(i) State what is meant by critical angle.

Apakah yang dimaksudkan dengan sudut genting

.....

..... [1m]

- (ii) Calculate the critical angle of light in glass

Hitung sudut genting sinar cahaya didalam kaca

[2m]

3. Diagram 5.1 and Diagram 5.2 show a light ray passing through prism P and prism Q, respectively. *Rajah 5.1 dan Rajah 5.2 menunjukkan sinar cahaya merambat melalui prisma P dan prisma Q, masing-masing.*

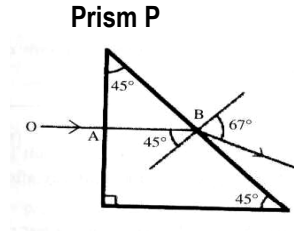


Diagram 5.1

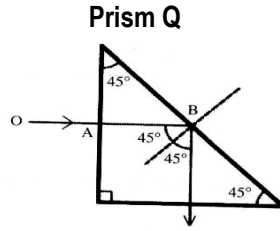


Diagram 5.2

- (a) What is meant by critical angle? Tick (✓) the correct answer in the box provided.

Apa yang dimaksudkan dengan sudut genting? Tandakan (✓) jawapan yang betul dikotak yang disediakan.

The angle of incidence when the angle of refraction is 90° ☐

Sudut tuju bila sudut pembiasan 90°

The angle of incidence when the incident ray is totally reflected ☐

Sudut tuju bila sinar cahaya dipantulkan sepenuhnya [1 mark]

- (b) Explain why the light ray does not bend when it enters both prisms at point A.

Terangkan kenapa sinar cahaya tidak dibengkokkan bila ia memasuki kedua-dua prisma di titik A.

.....[1 mark]

- (c) (i) Based on Diagram 5.1 and Diagram 5.2, how can the angle of incidence at point B be made equal to the critical angle?

Berdasarkan Rajah 5.1 dan Rajah 5.2 terangkan bagaimana sudut tuju di titik B dapat disamakan dengan sudut genting?

Prism P:

Prism Q:[2 marks]

- (i) Diagram 5.1 shows the light ray passing from glass to air at point B. Compare the density of glass with the density of air.

Rajah 5.1 menunjukkan sinar cahaya merambat dari kaca ke udara di titik B. Bandingkan ketumpatan kaca dan ketumpatan udara

.....[1 mark]

- (ii) Based on Diagram 5.1 and Diagram 5.2, what happen to the light ray after passing point B? *Berdasarkan Rajah 5.1 dan Rajah 5.2, apa yang berlaku pada cahaya selepas melalui titik B?* Diagram 5.1

.....
Diagram 5.2

.....[2 marks]

- (d) Name the phenomenon shown in Diagram 5.2. *Namakan fenomena yang ditunjukkan pada Rajah 5.2.*

.....[1 mark]

- 4(a) Explain what is meant by total internal reflection.

Terangkan apa yang dimaksudkan dengan pantulan dalam penuh.

.....

.....[1m]

- (b) Fig. 7.1 shows a ray of light, travelling in air, incident on a glass prism.

Rajah 7.1 menunjukkan satu sinar cahaya yang merambat diudara menuju kearah prisma kaca.

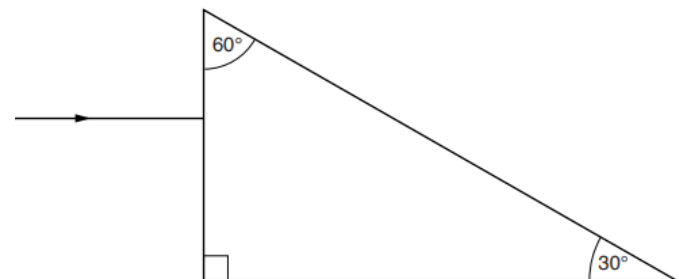


Figure 7.1

- (i) The speed of light in air is 3.0×10^8 m/s. Its speed in the glass is 2.0×10^8 m/s. Calculate the refractive index of the glass.

Laju cahaya diudara ialah 3×10^8 m/s dan laju cahaya dalam prisma kaca ialah 2.0×10^8 m/s. Hitung indeks biasan prisma kaca tersebut.

[2m]

- (ii) Calculate the critical angle for the glass-air boundary. *Hitung sudut genting bagi prisma kaca tersebut.*

[2m]

- (iii) On Fig. 7.1, draw carefully, without calculation, the continuation of the ray through the prism and into the air.

Pada Rajah 7.1, lengkapkan sinar cahaya melalui prisma sehingga keluar ke udara
[3m]

5. Fig. 6.1 shows a ray of light, from the top of an object PQ, passing through two glass prisms.
Rajah 6.1 menunjukkan sinar cahaya, dari bahagian atas objek PQ, melalui dua prisma kaca.

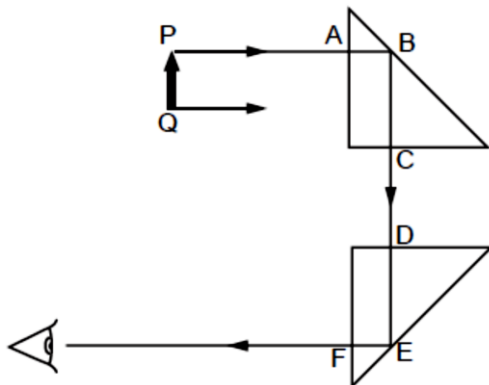


Fig 6.1

- (a) Complete the path through the two prisms of the ray shown leaving Q.
[1]
Lengkapkan lintasan cahaya dari Q dan memasuki dua prisma tersebut.

- (b) A person looking into the lower prism, at the position indicated by the eye symbol, sees an image of PQ.
State two characteristics of this image.
Seseorang melihat melalui prisma bawah, pada kedudukan yang ditandakan dengan symbol mata dan melihat imej PQ. Nyatakan dua ciri imej

.....[2]

- (c) Explain why there is no change in direction of the ray from P at points A, C, D and F.
Terangkan kenapa tiada perubahan dalam arah perambatan cahaya dari titik P di titik A, B, C dan D.

.....[1]

- (d) (i) Name the physics concept involved when the light strike the prism at point B and E.
Namakan konsep fizik yang terlibat bila cahaya mengenai prisma pada titik B dan E.

.....[1]

- (ii) State two conditions for the physics phenomenon in d(i) to occur.

Nyatakan dua syarat untuk fenomena fizik di(d)(i) berlaku.

.....

.....[2]

- (e) The speed of light as it travels from P to A is 3×10^8 m/s and the refractive index of the prism glass is 1.5. Calculate the speed of light in the prism.
Laju cahaya bila merambat dari P ke A ialah 3×10^8 m/s dan indeks pembiasan prisma kaca ialah 1.5. Hitung kelajuan cahaya di dalam prisma.

[2]

6. Diagram 4.1 shows a submarine equipped with an optical instrument P. Diagram 4.2 shows the structure of the optical P.
Rajah 4.1 menunjukkan sebuah kapal selam dilengkapi dengan alat optik P. Rajah 4.2 menunjukkan struktur alat optik P.

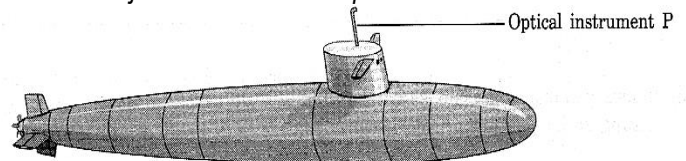


Diagram 4.1

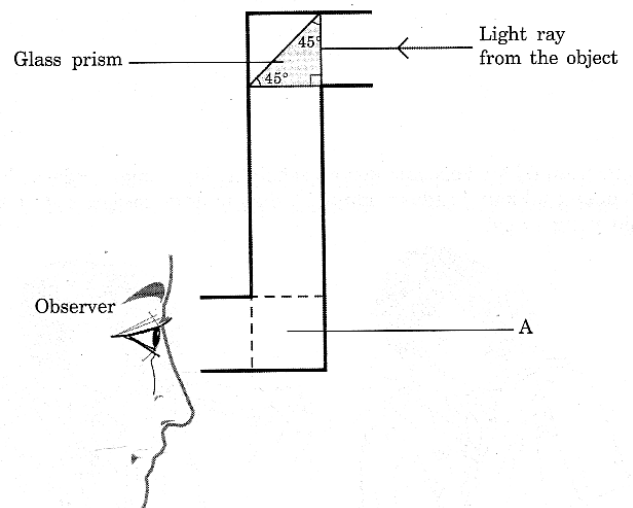


Diagram 4.2

- (a) Name the optical instrument P / Namakan alat optik P.

.....[1 mark]

- (b) In Diagram 4.2, two glass prisms must be placed so that the object can be seen by the observer. The position of one of the glass prisms is as shown. Pada Rajah 4.2 dua prisma kaca mesti diletakkan supaya objek dapat dilihat oleh pemerhati. Kedudukan salah satu dari prisma kaca ditunjukkan.

- (i) In box A in Diagram 4.2, draw and shade the second prism.

[1 mark]

Pada kotak A pada Rajah 4.2, lukis dan lorekan prisma yang kedua.

- (ii) Explain why the prisms in optical instrument P are placed as in (b)(i).

Terangkan kenapa prisma dalam alat optik P diletakkan seperti di (b)(i)

.....[1 mark]

- (c)(i) In Diagram 4.2, complete the path of the light ray from the object to the observer's eye.

[1 mark]

Pada Rajah 4.2, lengkapkan lintasan cahaya dari objek ke mata pemerhati.

- (ii) State one characteristics of the image observed.

Nyatakan satu ciri imej yang diperhatikan.

.....[1 mark]

- (d) The refractive index of the glass prism is 1.52. Calculate the critical angle of the glass prism. Indeks pembiasan prisma kaca ialah 1.52. Hitung sudut genting prisma kaca.

[2 marks]

- (e)(i) Underline the correct phrase to complete the following statement. Critical angle is angle of incidence when angle of refraction is (less than, same as, more than) 90° . [1]

Gariskan pernyataan yang betul untuk melengkapi ayat yang berikut. Sudut genting adalah sudut tuju bila sudut pembiasan (kurang dari, sama dengan, lebih dari) 90° .

- (ii) State why the ray is not deviated as it passes through the surface into the glass at A.

Nyatakan kenapa cahaya tidak dibengkokkan bila ia merambat kedalam kaca di titik A.

.....[1]

- (iii) On Fig. 7.1, use a ruler to help you draw the rest of the path of the ray, until it has emerged again into the air. [3]

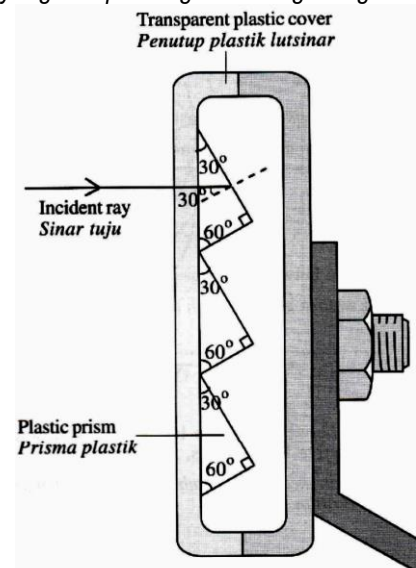
Pada Rajah 7.1, gunakan pembaris untuk membantu anda melukis lintasan cahaya yang selanjutnya sehingga ia keluar ke udara.

- (b) Fig. 7.2 shows a periscope that uses two plane mirrors.

Rajah 7.2 menunjukkan sebuah periskop yang menggunakan dua cermin satah.

7. Diagram 7 shows the structure of a rear reflector of a bicycle created by a student. The reflector consists of identical plastic prisms which have critical angle of 42° .

Rajah 7 menunjukkan struktur sebuah pemantul belakang sebuah basikal yang direka oleh seorang pelajar. Pemantul itu mengandungi prisma-prisma plastik yang serupa dengan sudut genting 42° .



- (a) What is the meaning of critical angle? Apakah yang dimaksudkan dengan sudut genting?

.....[1 mark]

- (b)(i) On diagram 7, complete the ray of light after entering the reflector.

Pada Rajah 7, lengkapkan sinar cahaya selepas memasuki pemantul itu.

[1 mark]

- (ii)Based on answer in(b)(i), what happens to the ray of light after entering the reflector. Give one reason for your answer.

Berdasarkan jawapan pada (b)(i), apakah yang berlaku kepada sinar cahaya selepas memasuki pemantul itu. Beri satu sebab bagi jawapan anda.

.....

.....[2 marks]

- (c)Based on the observation in (b)(ii), the student found that a few modifications should be made so that the reflector reflects more light. The modifications are based on the following aspects:

Berdasarkan pemerhatian dalam (b)(ii), pelajar itu mendapati beberapa pengubahsuaian perlu dibuat supaya pemantul itu dapat memantulkan lebih banyak cahaya. Pengubahsuaian adalah berdasarkan aspek-aspek berikut:

- (i)The angle of prism used /Sudut prisma yang digunakan

.....[1 mark]

Reason / sebab

.....[1 mark]

- (ii)Number of prism used
Bilangan prisma yang digunakan

.....[1 mark]

Reason / sebab

.....[1 mark]

- (d)Based on the prism in Diagram 7, calculate the refractive index of the plastic prism used.
Berdasarkan prisma pada Rajah 7, hitung indeks biasan prisma plastic yang digunakan.

[2 marks]

8. Rajah 8 menunjukkan sebarang cincin yang mengandungi batu permata.

Diagram 8 shows a ring that consist of gemstone.



Rajah 8 / Diagram 8

- (a)Batu permata itu berkilau. Nyatakan fenomenon fizik yang terlibat.
The gemstone sparkles. State the physics phenomenon involved.

.....[1 mark]

- (b)Indeks biasan bagi batu permata cincin tersebut ialah 1.5. Hitung sudut genting bagi batu permata itu.

The refractive index of the ring's gemstone is 1.5. Calculate the critical angle of the gemstone.

[2 marks]

- (c)Sekiranya batu permata pada Rajah 8 kurang berkilau, nyatakan ciri bagi aspek-aspek berikut untuk menggantikan batu permata pada Rajah 8 supaya lebih berkilau.

If the gemstone in Diagram 8 is less sparkle, state the characteristic of the following aspects to replace the gemstone in Diagram 8 to be more sparkled.

- (i)Sudut genting / Critical angle

.....[1 mark]

Sebab / Reason

.....[1 mark]

- (ii)Ketumpatan optik / Optical density

.....[1 mark]

Sebab / Reason

.....[1 mark]

(iii) Permukaan batu permata / Surface of gemstone

.....[1 mark]

Sebab / Reason

.....[1 mark]

9. Diagram 8.1 shows an incomplete light ray path entering a glass prism. The refractive index of the prism is 1.5.

Rajah 8.1 menunjukkan lintasan sinar cahaya yang tidak lengkap merambat masuk kedalam prisma kaca. Indeks pembiasan ialah 1.5

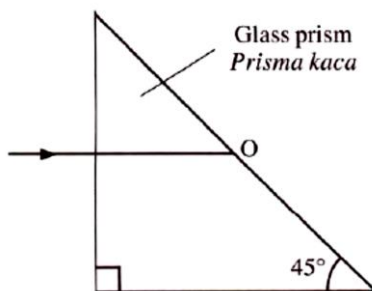


Diagram 8.1

- (a)(i) Calculate the critical angle of the glass prism.
Hitung sudut genting prisma kaca.

[2 marks]

- (ii) On Diagram 8.1, complete the light ray path from point O.
Pada Rajah 8.1, lengkapkan lintasan cahaya dari titik O

- (iii) Based on the answer in (a)(ii), name the light phenomenon involved.
Berdasarkan pada jawapan di(a)(ii), namakan fenomena cahaya yang terlibat.

.....[1 mark]

- (b) Diagram 8.2 shows prism binoculars. The position of two prisms on one side of the binoculars is as shown.

Rajah 8.2 menunjukkan binocular prisma. Kedudukan dua prisma pada satu belah binocular

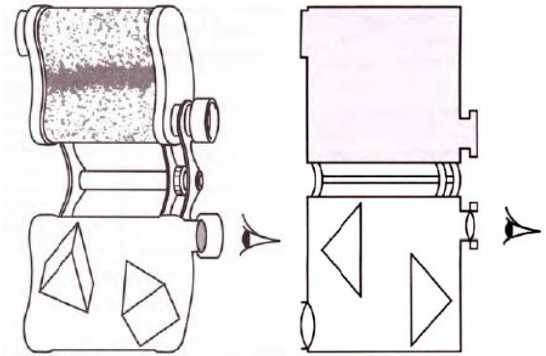


Diagram 8.2

Diagram 8.3

Diagram 8.3 is a schematic diagram of Diagram 8.2. On Diagram 8.3 draw the ray path entering both prisms. In your drawing show the direction of the ray path.
Rajah 8.3 adalah rajah berskema bagi Rajah 8.2. Pada Rajah 8.3 lukis lintasan cahaya yang merambat melalui dua prisma. Pada lukisan anda tunjukkan arah lintasan cahaya.

[2 marks]

- (c) Objective lens is used in the binoculars so that the object can be seen clearer. Table 8 shows characteristics of three lenses.

Kanta objek digunakan dalam binocular supaya objek dapat dilihat dengan lebih jelas. Jadual 8 menunjukkan ciri-ciri tiga kanta.

Lens	Focal length	Diameter of lens
P	1.0cm	small
Q	10.0cm	big
R	100.0cm	big

Table 8

Based on table 8 state the suitable characteristics of the lens to use as the objective lens. Give one reason for the suitable characteristics.

Berdasarkan jadual 8 nyatakan ciri-ciri kanta yang sesuai untuk digunakan sebagai kanta objektif. Berikan sebab untuk kesesuaian ciri-ciri

- (i) Focal length of the lens: / panjang focus kanta

.....[1 mark]

Reason / sebab

.....[1 mark]

- (ii) Diameter of lens / diameter kanta

.....[1 mark]

Reason / sebab

.....[1 mark]

10. Fig. 2.1 shows a ray of light PQR passing along a simple optical fibre to its end at R.
Rajah 2.1 menunjukkan satu sinar cahaya PQR merambat disepanjang satu gentian kaca ringkas ke hujung R.

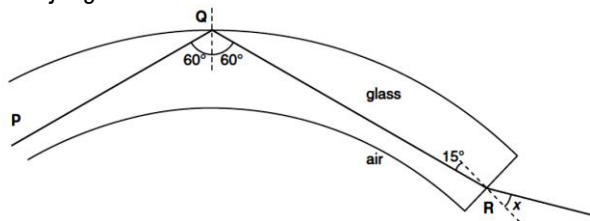


Fig. 2.1

- (a) (i) Explain why the ray PQ does not leave the optical fibre at Q.
Terangkan kenapa sinar PQ tidak meninggalkan gentian optik di Q

.....

.....[2m]

- (ii) Explain why the ray QR changes direction at R.
Terangkan kenapa lintasan cahaya QR berubah arah di R

.....

.....

.....

.....[3m]

- (b) The refractive index of glass is 1.5. The ray QR makes an angle of 15° with the normal to the glass surface at R. Calculate the angle x, shown on Fig. 2.1.
Indeks biasan kaca ialah 1.5. Sinar cahaya QR membuat sudut 15° dengan garis normal dengan kaca dititik R. Hitung sudut x, yang ditunjukkan pada Rajah 2.1

[2]

- (c) State one advantage of optical fibres rather than copper wires for carrying telephone communications.
Nyatakan satu kelebihan menggunakan gentian optik berbanding dawai kuprum dalam telekomunikasi telefon

.....[1]

13. Diagram 11 shows a light signal traveling through an optical fiber made of glass.
Rajah 11 menunjukkan sinar cahaya merambat melalui gentian optik yang dibuat dari kaca.

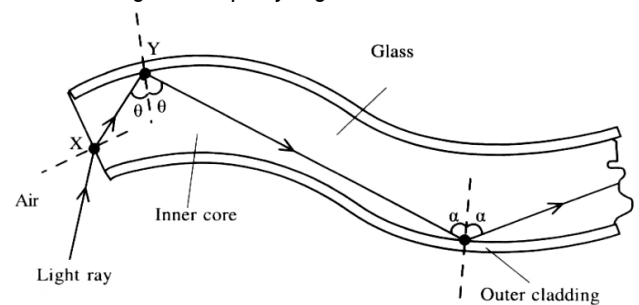


Diagram 11

- (a) Name the phenomenon involved at Y. [1 mark]
Namakan fenomena cahaya yang terlibat di Y

- (b) (i) State two changes that happen to the light ray when it passes from air into the optical fiber at X. [2 marks]
Nyatakan dua perubahan yang berlaku pada cahaya bila ia merambat dari udara ke gentian optik di X.

- (ii) Explain why the light ray follows the path shown in Diagram 11.1 when it hits the wall of the optical fibre at Y. [2 marks]
Terangkan kenapa cahaya mengikut lintasan seperti yang ditunjukkan pada Rajah 11 apabila ia mengenai dinding gentian optik di Y.

- (c) The optical fiber in Diagram 11.1 can be used in telecommunications and medicine. You are asked to investigate the characteristics of optical fibres for use in these fields as shown in Table 11.
Gentian optik di Rajah 11.1 boleh digunakan dalam bidang telekomunikasi dan perubatan. Anda di minta mengkaji ciri-ciri gentian optik untuk digunakan dalam bidang yang dinyatakan seperti yang ditunjukkan pada Jadual 11.
Explain the suitability of each feature of optical fiber in Table 11 for use in telecommunications and medicine. Determine the most suitable optical fiber that is capable of carrying the largest number of signals simultaneously.

[10 marks]

Terangkan kesesuaian setiap ciri gentian optik dalam Jadual 11 untuk digunakan dalam bidang telekomunikasi yang boleh membawa bilangan isyarat yang banyak serentak

- (d) Diagram 11.2 and Diagram 11.3 show a ray of light passing into glass and diamond respectively.

Rajah 11.2 dan Rajah 11.1 menunjukkan satu sinar cahaya merambat ke dalam kaca dan intan

[Refractive index : Glass = 1.50 ; Diamond = 2.42]
[Indeks biasan: Kaca 1.50; Intan 2.42]

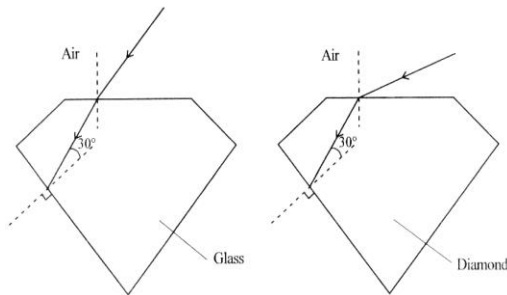


Diagram 11.2
Diagram 11.3

- (i) Calculate the critical angle of diamond and of glass.
Hitung sudut genting intan dan kaca [2 marks]
- (ii) Copy Diagram 11.2 and Diagram 11.3 and complete the path of the light ray in glass and in diamond until it finally emerges from each object. [3 marks]
Salin gamabarajah 11.2 dan 11.3 dan lengkapkan lintasan sinar cahaya didalam kaca dan intan sehingga sinar cahaya merambat keluar dari setiap objek.

Optical fiber	Features of optical fiber Struktur gentian optik	Comparison between refractive index of the inner core, n_i , and the outer cladding, n_0 Perbandingan antara indeks pembiasan teras dalam, n_i , dan teras luar, n_0	Flexibility Kelenturan	Purity of the inner core. Ketulenan teras dalam
P	Single fine optical fibers Gentian optik tunggal yang halus	$n_i > n_0$	High Tinggi	Very high Sangat tinggi
Q	Bundles of fine parallel optical fibers Berkas gentian optik selari yang halus	$n_0 > n_i$	Low Rendah	Low Rendah
R	Bundles of fine parallel optical fibers Berkas gentian optik selari yang halus	$n_i > n_0$	High Tinggi	Very high Sangat tinggi
S	Single fine optical fibers Gentian optik tunggal yang halus	$n_i > n_0$	Low Rendah	High Tinggi
T	Bundles of fine parallel optical fibers Berkas gentian optik selari yang halus	$n_0 > n_i$	High Tinggi	High Tinggi