YEAR 11 PHYSICS TERM 3 TEST 1

W-84

1. Sound travels at 3.40×10^2 ms^{-1} in air. What is the wavelength of a 2.50×10^3 Hz note? (3)

2. The crests of the waves behind a speed boat are 4.00m apart, and the crests pass a post in the river at 3 per second. What is the velocity of the disturbance in the water? (3)

3. Using diagrams, show amplitude, wavelength, period for a wave travelling through a medium. (4)

4. A piston completes 500.0 oscillations per minute in an engine. Determine : (a) its frequency.
   (b) its period. (3)

5. A rock is thrown into a still pond, and after 7.00s 56 wave crests have spread out from the impact point. The radius of the outermost crest is 2.40 m.
   (a) Calculate the wavelength and velocity of the wave.
   (b) Draw a displacement - distance graph for the first 10.0cm of surface from the impact point.
   (c) Draw a displacement - time graph for a particle on the surface 5.00 cm from the impact point. (Take the impact of the stone as t = 0).
   (8)

YEAR 11 PHYSICS TERM 3 TEST 1

1. $c = 3.60 \times 10^2 \text{ ms}^{-1}$
$\nu = 2.50 \times 10^3 \text{ Hz}$
$\lambda = ?$

$c = \nu\lambda$

$\Rightarrow \lambda = \frac{c}{\nu}$

$= \frac{3.60 \times 10^2}{2.50 \times 10^3}$

$= 0.136 \text{ m}.$

∴ the wavelength is 0.136 m. (3)

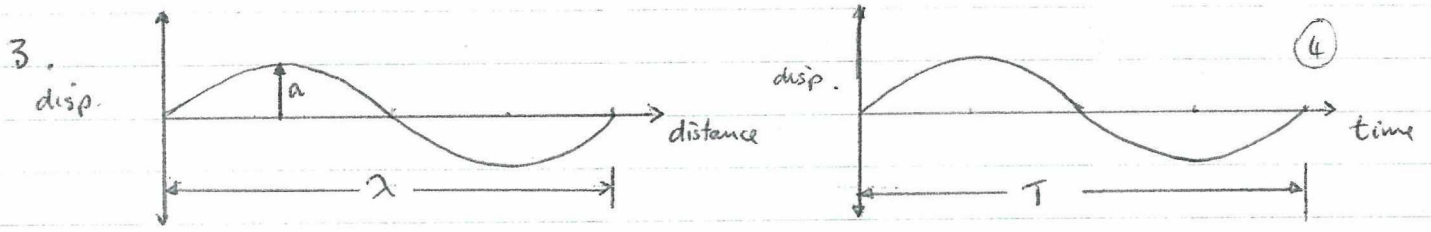
2. $c = ?$
$\nu =$
$\lambda = 4.00 \text{ m}$

$\nu = 3 \text{ Hz}.$

$c = \nu\lambda$
$= (3)(4.00)$
$= 12.0 \text{ ms}^{-1}$

∴ wave speed is 12.0 ms^{-1}. (3)

3.



(4)

4. (a) $\nu = \frac{500}{60.0}$
$= 8.33 \text{ Hz}.$

∴ frequency is 8.33 Hz

(b) $T = \frac{1}{\nu}$
$= \frac{1}{8.33}$
$= 0.120 \text{ s}.$

Period is 0.120 s. (3)

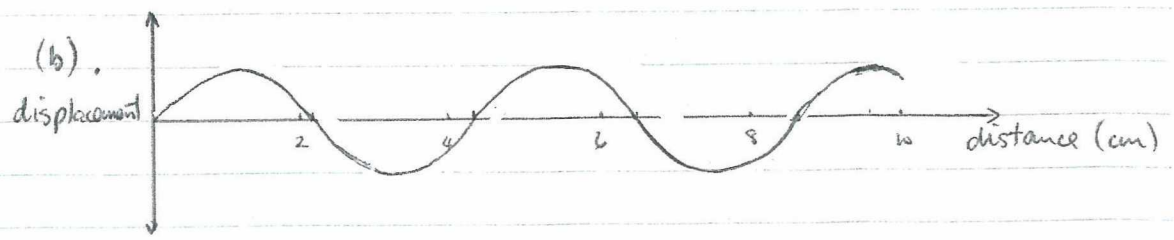
5. (a) $\lambda = \frac{2.40}{56}$
$= 0.0429 \text{ m}$
$= 4.29 \times 10^{-2} \text{ m}.$

∴ wavelength is $4.29 \times 10^{-2} \text{ m}$

$c = \frac{2.40}{7.00}$
$= 0.343 \text{ ms}^{-1}$

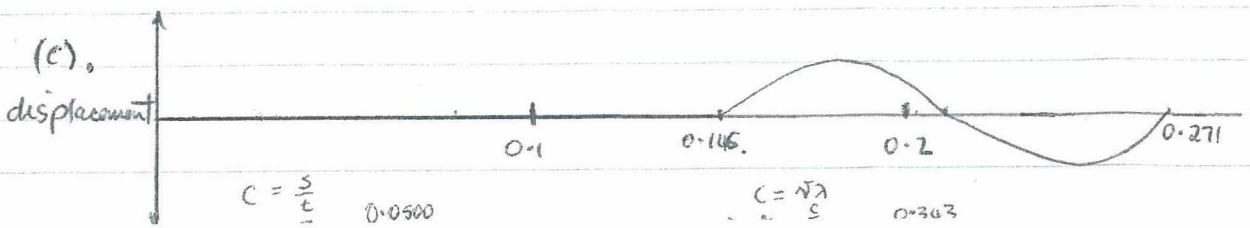
∴ wavespeed is 0.343 ms^{-1}. (2)

(b).



(2)

(c).



(4).

$c = \frac{s}{t}$ 0.0500

$c = \nu\lambda$ 0.343

YEAR 11 PHYSICS TERM 3 TEST 2

W-84

1. A wave generator on a ripple tank is operating so that it has a period of 0·100s. If the wavelength of the waves produced is 2·50cm;
   (a) calculate the wave velocity
   (b) draw graphs to show amplitude, wavelength and period. (3)

2. Using a diagram, explain the law of reflection. (3)

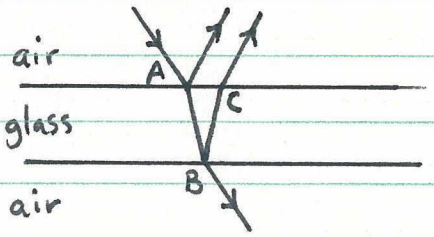
3. Use a diagram to help explain refraction. Include information on what happens to wave velocity, frequency and wavelength when a wave enters a new medium. (5)

4. Explain why a sound made outside a door can be heard anywhere inside the room. (2)

5. What conditions are necessary to produce a standing wave? (2)

6. A $4{\cdot}80\times10^{2}$ Hz tuning fork is sounded above an open tube. If the velocity of sound is $3{\cdot}40\times10^{2}\ ms^{-1}$ and the air column resonates at its 5th harmonic:
   (a) draw a diagram showing the wave pattern in the pipe.
   (b) calculate the length of the pipe. (3)

7. Light of wavelength $4{\cdot}90\times10^{-7}$m is incident upon a slab of glass surrounded by air, and light is reflected from both faces.



   (a) What is the condition of the reflected ray $\vec{BC}$?
   (b) What minimum film thickness is needed for destructive interference to occur? (3)

YEAR 11 PHYSICS TERM 3 TEST 2.

W-84

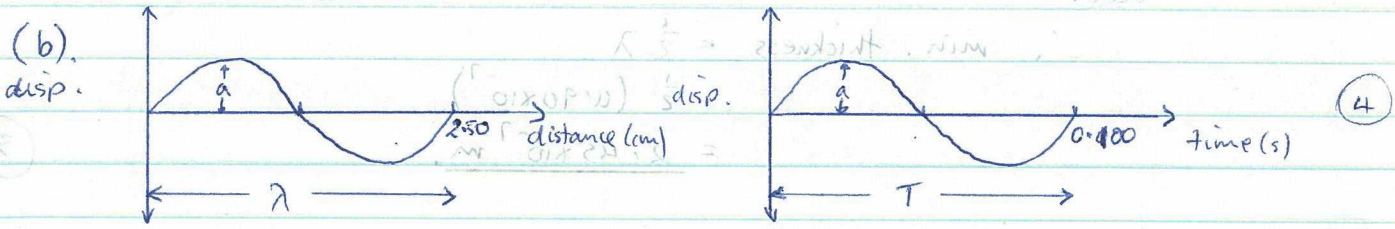
1. (a) $c = ?$ $\quad c = v\lambda$

$v = \quad = \frac{1}{T}$

$\lambda = 2.50\text{cm} \quad = \frac{2.50\times10^{-2}}{0.100}$

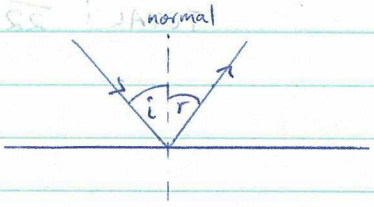
$T = 0.100\text{s} \quad = 2.50\times10^{-1}\ \text{ms}^{-1}$

(b).



(4)

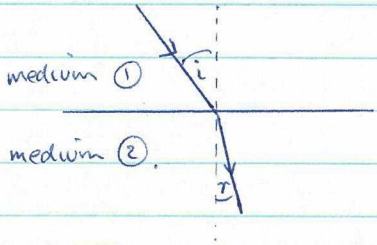
2.



1. Angle of incidence = angle of reflection

2. Incident ray and reflected ray are on opposite sides of the normal, and all 3 are in the same plane. (3)

3.



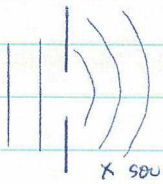
Refraction occurs when a wave enters a different medium obliquely. The wave alters its direction of travel.

Wave velocity decreases in a more dense medium or more rigid medium

∴ Wavelength decreases

Frequency is not affected. (5)

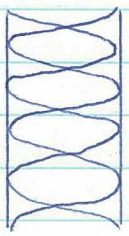
4. The sound diffracts, or spreads out, beyond the door into the room. This occurs since the door width ~ λ of sound.



(2).

5. Standing wave: two waves travelling in opposite directions in the same medium with the same wavelength, speed and amplitude. (2)

6. (a).



$\ell = 2\frac{1}{2}\lambda$.

(b) $\lambda = \frac{c}{v}$

$= \frac{3.40\times10^{2}}{4.80\times10^{2}}$

$= 0.708\ \text{m}$

$\therefore \ell = \frac{5}{2}\lambda$

$= 1.77\text{m}$

(3).

7. (a) Since $\overrightarrow{AB}$ travels in glass (optically more dense) to air, then $\overrightarrow{BC}$ is <u>reflected in phase.</u>

(b) Since ray reflected at A has 180° phase change, then if the film thickness is $\frac{1}{2}\lambda$ thick, destructive interference will occur.

$\therefore$ min. thickness $= \frac{1}{2}\lambda$

$= \frac{1}{2}(4.90\times10^{-7})$

$= \underline{2.45\times10^{-7}\ m}$.

(3)

TOTAL : $\overline{22}$.

YEAR 11 PHYSICS TERM 3 TEST 3.

1. Explain what is meant by the term "dual nature of light". (2)

2. Why does a prism disperse white light? (2)

3. Light is incident upon a double slit arrangement. Describe the image seen on a screen placed behind this arrangement. (2)

4. A person 1·70m tall can just see the whole of his body in the mirror of his wardrobe. If the mirror does not reach the floor and his eyes are 8·00cm below his height, calculate:
   (a) how far the mirror is from the floor, and
   (b) the minimum height of the mirror. (4)

5. Explain, using a diagram, what is meant by the term "conjugate foci". (2)

6. Which mirror can be used to produce:
   (a) a real, inverted, diminished image.
   (b) an up right, virtual image. (6)

   For each of the above, draw a ray diagram to show how the image is formed.

7. Calculate the size, nature and position of a 4·00cm high object placed 10·0 cm in front of a convex mirror of focal length 6·00 cm. (5)

8. What is "spherical aberration" and how is it overcome? (2)

9. A concave mirror has a focal length of 9·00cm. An object is situated so that it forms a virtual image twice the size of the object. Calculate the object and image distance from the mirror. (4)

TOTAL: 29.

YEAR 11 PHYSICS TERM 3 TEST 3

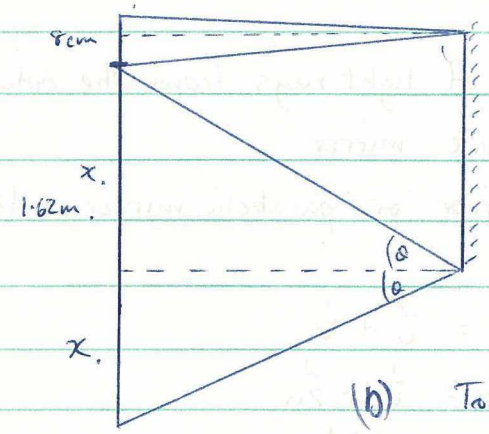
W-84

1. Dual nature: light exhibits wave properties and particle properties. (2)

2. Each colour of light has a different refractive index in glass, so they are refracted different amounts. (2)

3. Have a bright central image surrounded by alternate dark, light, dark, light, areas. (2)

4. (a).



From the diagram: since $\angle\theta$ is same,

then $x = x$

and $2x = 1.62\text{m}$

$\therefore x = 0.81\text{m}$. (2)

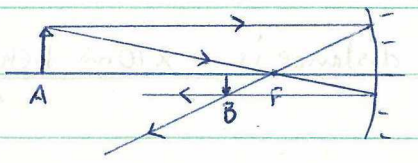
(b) To see the top of the head, the mirror must be $\frac{0.08}{2}$ m above the eyes.

$\therefore$ minimum height of mirror $= 0.81 + 0.04$

$= 0.850\text{ m}$ (2)

$\therefore$ mirror is 0.810m from the floor and 0.850m long at least.

5.

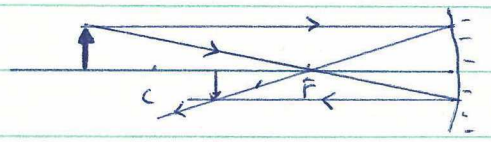


Object at A forms an image at B.

Object at B forms an image at A.

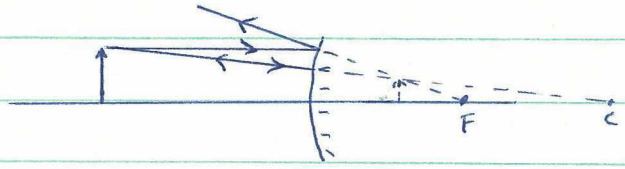
$\therefore$ A and B are conjugate foci. (2)

6. (a).



concave mirror with object outside 2F. (3)

(b)



convex mirror. (3)

7. $u = 0.100\,m$

$h_o = 0.0400\,m$

$f = -0.0600\,m.$

$\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$

$\Rightarrow \frac{1}{v} = \frac{1}{f} - \frac{1}{u}$

$= -\frac{1}{0.06} - \frac{1}{0.100}$

$= -26.66$

$\therefore v = -0.0375\,m.$

$m = \left|\frac{v}{u}\right| = \frac{h_i}{h_o}$

$\Rightarrow h_i = \frac{h_o \cdot v}{u}$

$= \frac{(0.0400)(0.0375)}{0.100}$

$= 0.0150\,m.$ (5)

$\therefore$ image is 0.0375 m behind the mirror, virtual and upright and 0.0150m high.

8. Spherical aberration: non-focussing of light rays from the outer parts of a large aperture mirror.

Solution: use small aperture mirror or parabolic mirror. (2)

9. $m = \left|\frac{v}{u}\right| = 2$

$\therefore |v| = 2u$

$\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$

$\Rightarrow \frac{1}{0.0900} = \frac{1}{u} + \frac{1}{2u}$

$= \frac{2+1}{2u}$

$\Rightarrow \frac{1}{0.0900} = \frac{3}{2u}$

$\therefore u = \frac{3}{2} \times 0.0900$

$= 0.135\,m$

$\therefore v = -0.270\,m$ (4)

$\therefore$ object distance is 0.135 m and the image distance is 0.270m behind the mirror.

YEAR 11 PHYSICS TERM 3 TEST 4.

W-84

1. If the diameter of the moon is 3477 km and its distance from the earth is 386 400 km, find the diameter of the image of the moon formed by a concave telescope mirror of focal length 3·00m. (4)

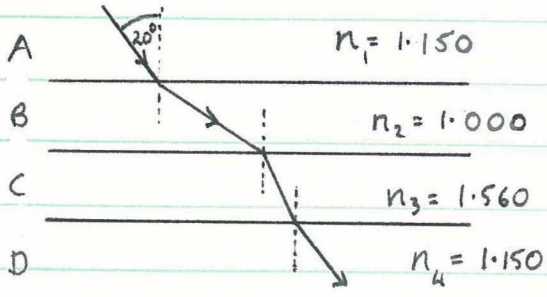
2. Explain completely how a concave mirror of radius of curvature 28·0 cm can be used to give a three times magnified, erect image of an object. (3)

3. An object is placed 0·240m in front of a convex mirror of focal length 0·150m. A plane mirror is placed between the object and convex mirror so that the images in each mirror coincide. Calculate the distance between the object and the plane mirror. (4)

4. Explain, using a diagram, why a pool appears shallower than it really is. (2)

5. Define "absolute refractive index." (2)

6. A light ray passes from benzene ($n = 1.501$) into water ($n = 1.333$). Given its angle of incidence on the interface is 10·0°, calculate:
   (a) the angle of refraction.
   (b) the relative refractive index for the two media
   (c) the critical angle for the combination. (5)

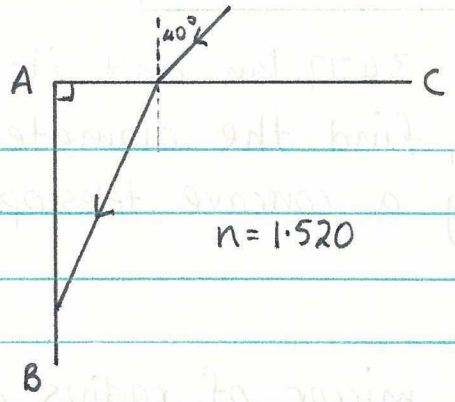
7. 

The angle of incidence at Boundary A-B is 20·0°. Calculate:
(a) angle of refraction in medium 2
(b) angle of refraction in medium 3

(4)

P.T.O.

8.



A ray of light is incident on a cube of glass at angle 40·0°. Determine whether the ray is reflected internally or refracted at surface AB.

(4)

TOTAL: 28

YEAR 11 PHYSICS TERM 3 TEST 4

1. $v = 3.864 \times 10^8$ m
$h_o = 3.477 \times 10^6$ m
$v = ?$
$h_i = ?$
$f = 3.00$ m.

$\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$

$\Rightarrow \frac{1}{v} = \frac{1}{f} - \frac{1}{u}$

$= \frac{1}{3.00} - \frac{1}{3.864 \times 10^8}$

$\therefore v = 3.00$ m

$m = \left|\frac{v}{u}\right| = \frac{h_i}{h_o}$

$\Rightarrow h_i = \frac{v \cdot h_o}{u}$

$= \frac{(3.00)(3.477 \times 10^6)}{3.864 \times 10^8}$

$= 0.02699$ m

$= 2.70 \times 10^{-2}$ m. (11)

$\therefore$ width of image is 2.70×10^{-2} m

2. $m = 3.00$
$f = 0.140$m
$u = ?$
$v = ?$

$m = \left|\frac{v}{u}\right| = 3.00$

$\therefore v = 3.00u$.

Since image is erect, it is virtual (i.e. v is -ve)

$\therefore \frac{1}{f} = \frac{1}{u} + \frac{1}{v}$

$\Rightarrow \frac{1}{0.140} = \frac{1}{u} - \frac{1}{3.00u}$

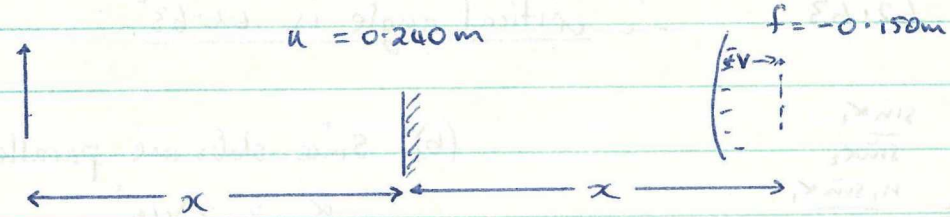
$= \frac{3.00 - 1}{3.00u}$

$\Rightarrow u = \frac{(2.00)(0.140)}{3.00}$ (3)

$= 0.09333$ m.

$\therefore$ to produce a magnified, erect image, the object must be 0.0933m in front of the mirror.

3.



$\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$

$\Rightarrow -\frac{1}{0.150} = \frac{1}{0.240} + \frac{1}{v}$

$\Rightarrow \frac{1}{v} = -\frac{1}{0.150} - \frac{1}{0.240}$

$\Rightarrow v = -0.0923$m.

From the diagram, $u + v = 2x$

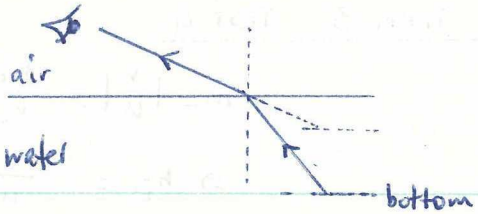
$\therefore x = \frac{u+v}{2}$

$= \frac{0.240 + 0.0923}{2}$ (4)

$= 0.166$m

$\therefore$ distance between object and plane mirror is 0.166m.

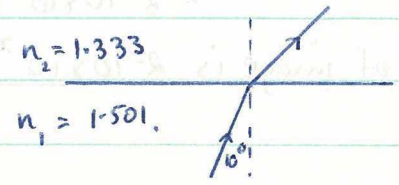
4.



Light from the bottom of the pool refracts away from the normal when it enters the air. Hence it is seen along a different line, given the appearance of shallowness.

5. Absolute refractive index: $n_x = \frac{c_{vacuum}}{c_{medium}}$.

6.



(a) $\frac{n_2}{n_1} = \frac{\sin\alpha_1}{\sin\alpha_2}$

$\Rightarrow \sin\alpha_2 = \frac{n_1 \sin\alpha_1}{n_2}$

$= \frac{1.501 \sin 10.0^\circ}{1.333}$

$\Rightarrow \alpha_2 = 11.28^\circ$.

$\therefore$ angle of refraction is 11.28°.

(b) $n_{1\to 2} = \frac{n_2}{n_1}$

$= \frac{1.333}{1.501}$

$= 0.8881$ i.e. relative refractive index of Medium ① to ② is 0.8881.

(c). $\frac{n_1}{n_2} = \frac{1}{\sin\alpha_c}$

$\Rightarrow \sin\alpha_c = \frac{1.333}{1.501}$

$\Rightarrow \alpha_c = 62.63^\circ$. $\therefore$ critical angle is 62.63°.

7. (a) $\frac{n_2}{n_1} = \frac{\sin\alpha_1}{\sin\alpha_2}$

$\Rightarrow \sin\alpha_2 = \frac{n_1 \sin\alpha_1}{n_2}$

$= \frac{1.150 \sin 20^\circ}{1.00}$

$\Rightarrow \alpha_2 = 23.16^\circ$.

$\therefore$ angle of refraction is 23.16°, in Medium 2.

(b) Since slabs are parallel, then

$\alpha_3 = 23.16^\circ$.

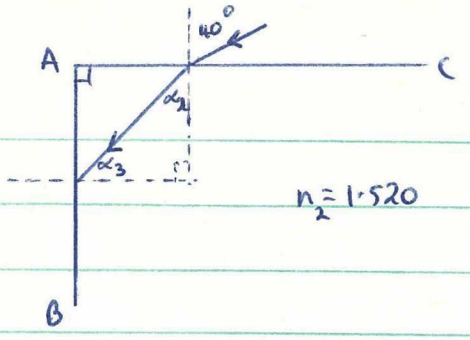
$\frac{n_3}{n_2} = \frac{\sin\alpha_3}{\sin\alpha_4}$

$\Rightarrow \sin\alpha_4 = \frac{1.000 \sin 23.16^\circ}{1.560}$

$\therefore \alpha_4 = 14.60^\circ$.

$\therefore$ angle of refraction in Medium 3 is 14.60°.

8.



$$\frac{n_2}{n_1} = \frac{\sin\alpha_1}{\sin\alpha_2}$$

$$\Rightarrow \sin\alpha_2 = \frac{n_1 \sin\alpha_1}{n_2}$$

$$= \frac{1.00 \sin 40.0^\circ}{1.520}$$

$$\Rightarrow \alpha_2 = 25.017^\circ.$$

$$\therefore \alpha_3 = 64.983^\circ.$$

To calculate α_c: $\frac{n_2}{n_1} = \frac{1}{\sin\alpha_c}$

$$\Rightarrow \sin\alpha_c = \frac{n_1}{n_2}$$

$$= \frac{1.000}{1.520}$$

$$\Rightarrow \alpha_c = 41.140^\circ.$$

$\therefore$ Since the angle of incidence at AB is greater than the critical angle, the ray is totally internally reflected.