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第十八章：光的反射与折射（2003年－2017年）.

选择题：

① 若 $n_A > n_B$, $v_B > v_A$, $\lambda_B > \lambda_A$

A.

② $n_{玻液} = \frac{\sin i_{液}}{\sin i_{玻}}$

$\frac{n_{玻}}{n_{液}} = \frac{\sin i_{液}}{\sin i_{玻}}$

$\frac{1.7}{n_{液}} = \frac{\sin 90}{\sin 46.8}$

$n_{液} = 1.24$ #

C

③ C

④ $\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$

$\frac{1}{12} + \frac{1}{v} = \frac{1}{8}$

$v = 24\,cm$ #

像 I_2 与物体的距离 $= (30-12)+8$

$= 44\,cm$ #.

C

⑤ (I) $\frac{n_B}{n_A} = \frac{\sin A}{\sin B}$

$= \frac{\sin 45}{\sin 60}$

$= 0.816$ #

(II) $\frac{n_B}{n_A} = \frac{\sin A}{\sin B}$

$0.816 = \frac{\sin 30}{\sin B}$

$B = 37.8°$ #

(III) $\frac{n_B}{n_A} = \frac{\sin A}{\sin B}$

$0.816 = \frac{\sin A}{\sin 90}$

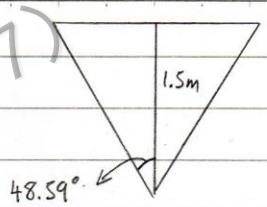
$A = 54.6°$ #

B.

⑥ $n_{水} = \frac{1}{\sin C}$

$\frac{4}{3} = \frac{1}{\sin C}$

$C = 48.59°$



$\tan 48.59 = \frac{r}{1.5}$

$r = 1.7\,m$ #

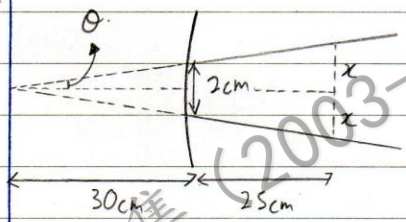
C

⑦ C

⑧ $\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$

$\frac{1}{10} + \frac{1}{v} = \frac{1}{13}$

$v = -30\,cm$.



$\tan\theta = \frac{1}{30}$

$\frac{x}{55} = \frac{1}{30}$

$x = 1.83\,cm$.

$2x = 3.7\,cm$ #

B

⑨ D.

⑩ C

⑪ $n = \frac{\sin i}{\sin r}$

$\frac{4}{3} = \frac{\sin 30}{\sin r}$

$r = 22.02°$ #

A

⑫ $n = \frac{1}{\sin C}$

$1.6 = \frac{1}{\sin C}$

$C = 38.68°$ #.

θ 必须小于 $90° - 38.68° = 51.32°$ #

B

(13) C.

(14) $n = \frac{\sin i}{\sin r}$

$= \frac{\sin 60}{\sin 49}$

$= 1.15$ #.

B.

(15) C

(16) $\frac{n_Q}{n_P} = n_1$; $\frac{n_R}{n_Q} = n_2$

$\frac{n_P}{n_R} = \frac{n_P}{n_Q} \times \frac{n_Q}{n_R}$

$= \frac{1}{n_1} \times \frac{1}{n_2}$

$= \frac{1}{n_1 n_2}$

D

(17) $n = \frac{1}{\sin C}$

$\sqrt{3} = \frac{1}{\sin C}$

$C = 35.26°$

D.

(18) 黄色光的速度较快 } $n = \frac{1}{\sin C}$

紫色光的速度较慢 } $\frac{c}{\uparrow v} = \frac{1}{\sin C \uparrow}$ 黄

$\frac{c}{\downarrow v} = \frac{1}{\sin C \downarrow}$ 紫

C (紫色光是全反射, 黄色光是反射和折射).

(19) $n_{玻空} = \frac{n_{玻}}{n_{空}}$; $n_{玻A} = \frac{n_{玻}}{n_A}$

$1.5 = \frac{n_{玻}}{n_{空}}$ $1.2 = \frac{n_{玻}}{n_A}$

(I) $n_{A空} = \frac{n_A}{n_{玻}} \times \frac{n_{玻}}{n_{空}}$

$= \frac{1}{1.2} \times 1.5$

$= 1.25$ #.

(II) $n_A = \frac{c}{v}$

$1.25 = \frac{3 \times 10^8}{v}$

$v = 2.4 \times 10^8 \, ms^{-1}$ #.

(III) $n_{玻} = 1.5$, $n_A = 1.25$.

C

(20) $n_g = \frac{D}{d}$

$\frac{3}{2} = \frac{5+4}{d}$

$d = 6$ cm. (平面镜下方 1 cm).

B

(21) $m = \left|\frac{v}{u}\right|$

$\frac{像高}{物高} = \left|\frac{v}{u}\right|$

$\frac{1}{0.25} = \frac{v}{5}$

$v = 20$ cm.

C

(22) $\tan i = \frac{40}{30}$

$i = 53.13°$

$\tan r = \frac{20}{30}$

$r = 33.69°$

$n = \frac{\sin i}{\sin r}$

$= \frac{\sin 53.13}{\sin 33.69}$

$= 1.44$ #.

A.

(23) $m = \left|\frac{v}{u}\right|$

$0.5 = \frac{-v}{u}$

$v = -0.5u$

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

$\frac{1}{u} - \frac{1}{0.5u} = \frac{1}{-10}$

$\frac{1-2}{u} = \frac{1}{-10}$

$u = 10$ cm. #

B.

(24) C.

(25) $\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$

$\frac{1}{40} + \frac{1}{-30} = \frac{1}{f}$

$f = -120$ cm #.

C.

(26) $n_{QP} = \frac{\sin P}{\sin Q}$ $n_P = \frac{c}{v}$

$\frac{n_Q}{n_P} = \frac{\sin 45}{\sin 36}$ $n_P = \frac{c}{0.8c}$

$\frac{n_Q}{1.25} = 1.20$ $= 1.25$

$n_Q = 1.5$

D.

(27)

(28) $n_{液} = \frac{\sin i}{\sin r}$ $n_{液} = \frac{1}{\sin C}$

$= \frac{\sin 48}{\sin 32}$ $1.4 = \frac{1}{\sin C}$

$= 1.40$ $C = 45.5°$ #

B

(29) $n = \frac{1}{\sin C}$

$n = \frac{1}{\sin \theta}$

$= 1 \div \frac{R}{R+d}$

$= 1 \times \frac{R+d}{R}$

$= \frac{R+d}{R}$

A

作答题：

(1) (i) $m = \left|\frac{V}{u}\right|$

$\frac{1}{10} = -\frac{V}{10}$

$V = -1\,m$

∴像在镜后 1 m 处。

(ii) $\frac{1}{u} + \frac{1}{V} = \frac{1}{f}$

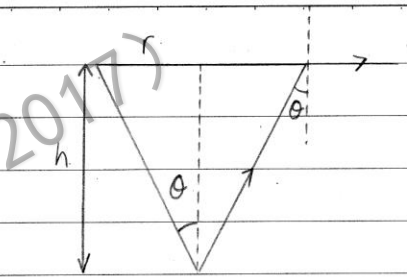
$\frac{1}{10} - \frac{1}{1} = \frac{1}{f}$

$f = -\frac{10}{9}\,m$

$r = -\frac{10}{9} \times 2$

$= -2.2\,m$ #

(2) (a)



$D = 2r$ $\tan\theta = \frac{r}{h}$

$= 2h\tan\theta$ # $r = h\tan\theta$

(b) $T = \frac{2\pi}{\omega}$ $6 \times \frac{30}{360} = 0.5\,s$ #

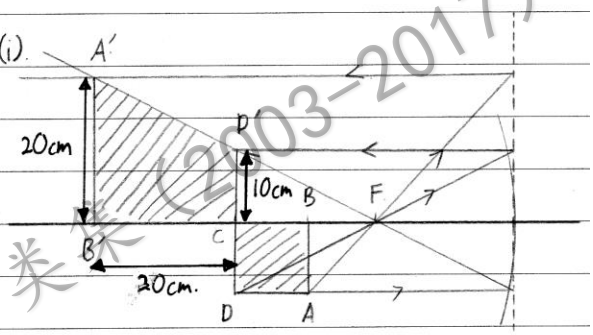
$= 2\pi \div \frac{\pi}{3}$

$= 2\pi \times \frac{3}{\pi}$ 平面镜转了 30° 时，反射光线则转了 60°。

$= 6$

∴最多不会超过 15 个点。

(3) (a)(i)



10 cm : 1 cm.

(ii) $\frac{1}{u} + \frac{1}{V} = \frac{1}{f}$ (B'点)

$\frac{1}{30} + \frac{1}{V} = \frac{1}{20}$

$V = 60\,cm$ #

$m = \left|\frac{V}{u}\right|$ (A'点)

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

$\frac{h_i}{10} = \frac{60}{30}$

$h_i = 20\,cm$

面积 $= \frac{1}{2}(20+10) \times 20$

$= 300\,cm^2$ #

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(b) 仪器：厚玻璃砖、激光器、白纸、量角器

步骤：① 把厚玻璃砖放在白纸上，在白纸上画出玻璃砖的外形。

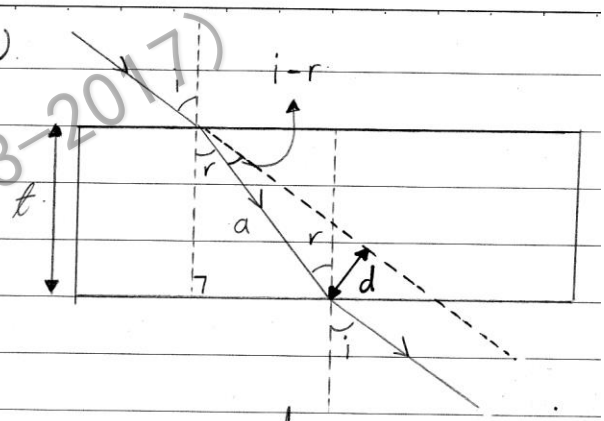
② 选定厚玻璃砖的其中的一直边为临界边。

③ 调整激光器使射出的光成一细线，让光线平行于纸面射入玻璃砖，并在临界边出射。

④ 逐渐调大入射角直到折射线突然消失，而反射线最强时，在白纸上标下入射点、出射点及反射点。

⑤ 拿开玻玻砖，连接白纸上的三点，量出反射线与入射线的夹角 θ，临界角 $C = \frac{1}{2}\theta$。

(b)



$\sin(i-r) = \frac{d}{a}$

$\sin(i-r) = d \times \frac{\cos r}{t}$

$d = \frac{t}{\cos r}\sin(i-r)$ #

$\cos r = \frac{t}{a}$

$a = \frac{t}{\cos r}$

④ (a) (i) $n = \frac{\sin i}{\sin r}$

$= \frac{\sin 30}{\sin 17}$

$= 1.71$ #

(ii) $c = f\lambda$

$3\times10^8 = f \times 6\times10^{-7}$

$f = 5\times10^{14}$ Hz #

(iii) $n = \frac{c}{v}$

$1.71 = \frac{3\times10^8}{v}$

$v = 1.75\times10^8 ms^{-1}$ #

(iv) $v = f\lambda$

$1.75\times10^6 = 5\times10^{14}\lambda$

$\lambda = 3.51\times10^{-7} m$ #

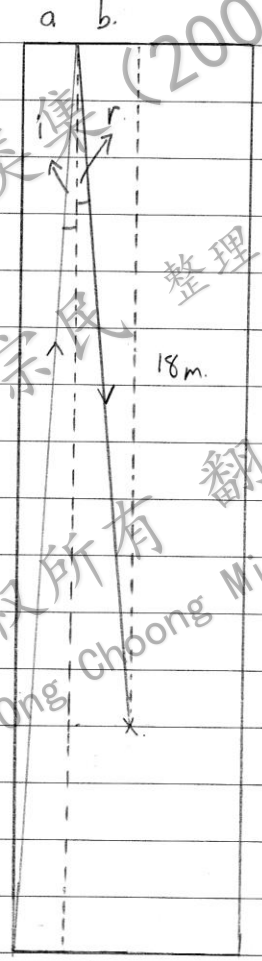
(v) $\frac{n_{lg}}{n_l} = \frac{\sin g}{\sin l}$

$\frac{n_l}{n_g} = \frac{\sin g}{\sin l}$

$\frac{1.36}{1.71} = \frac{\sin 17}{\sin l}$

$l = 21.57°$ #

⑤ (a)



2m : 1cm

$\tan i = \frac{a}{24}$, $\tan r = \frac{b}{18}$ $\Rightarrow \frac{a}{24} = \frac{b}{18}$

$18a = 24b$ ①

$a + b = 3$

$a = 3 - b$ ②

把②带入①

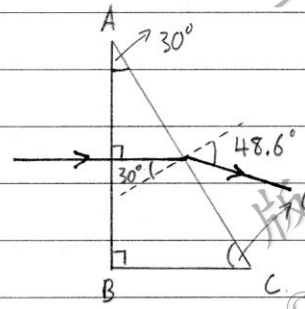
$18(3-b) = 24b$

$54 - 18b = 24b$

$b = 1.28\ m$ #

∴平面镜最小的宽度为 2.57 m。

(b)



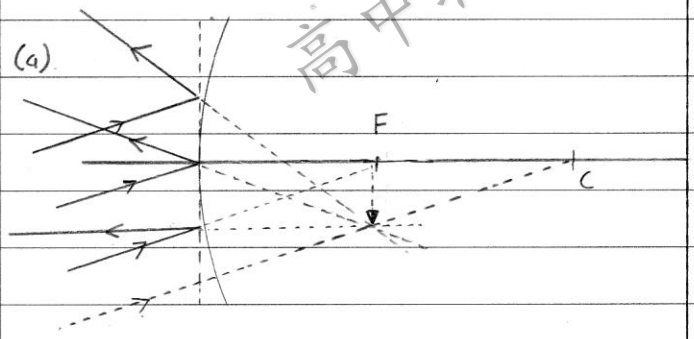
$n = \frac{1}{\sin C}$ $\quad n = \frac{\sin i}{\sin r}$

$1.5 = \frac{1}{\sin C}$ $\quad 1.5 = \frac{\sin i}{\sin 30}$

$C = 41.81°$ $\quad i = 48.6°$ #

(全反射不会发生)

(c) (a)



(b) (i) $n_{玻液} = \frac{\sin i_{液}}{\sin i_{玻}}$

$0.93 = \frac{\sin r}{\sin 35}$

$r = 32.24°$ #

(ii) $n_{\ell} = \frac{\sin i}{\sin r}$

$= \frac{\sin 60°}{\sin 32.24°}$

$= 1.62$ #

(iii) $n_{\ell} = \frac{c}{v}$

$1.62 = \frac{3 \times 10^8}{v}$

$v = 1.85 \times 10^8\ ms^{-1}$ #

(7) (a) (i) $\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$

$\frac{1}{15} + \frac{1}{v} = -\frac{1}{10}$

$v = -6\ cm$ #

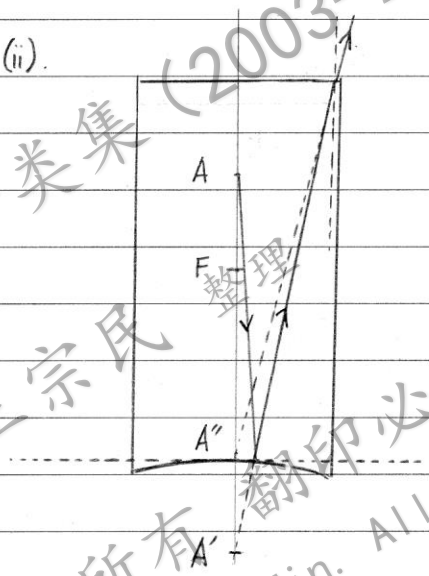
$n = \frac{D}{d}$

$1.33 = \frac{5+15+6}{d}$

$d = 19.5\ cm$ #

∴物体 A 在水面下 19.5 cm 处。

(ii)



(b) $n_{12} = \frac{\sin r_2}{\sin i_1}$

$\frac{n_1}{n_2} = \frac{\sin 90}{\sin \theta}$

$\sin \theta = \frac{n_2}{n_1}$

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(ii) $n = \frac{1}{\sin C}$

$\sqrt{3} = \frac{1}{\sin C}$

$C = 35.26°$ (不会发生全反射).

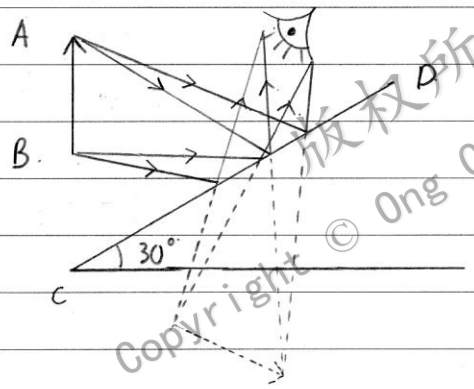
(8) $n_{液镜} = \frac{\sin i_{镜}}{\sin i_{液}}$

$\frac{n_{液}}{n_{镜}} = \frac{\sin i_{镜}}{\sin i_{液}}$

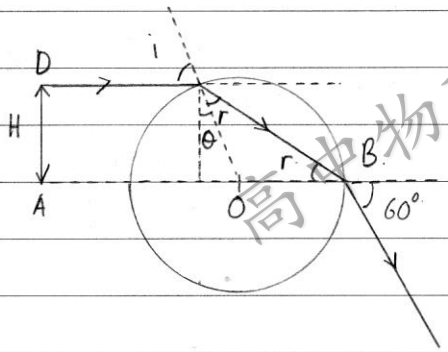
$\frac{1.2}{n_{镜}} = \frac{\sin 30}{\sin 46}$

$n_{镜} = 1.73.$

(9)



(10) (i)



$\cos\theta = \frac{H}{R}$

$\cos\theta = \frac{\sqrt{3}R}{2} \times \frac{1}{R}$

$\theta = 30°$

$n = \frac{\sin i}{\sin r}$

$= \frac{\sin(90-30)}{\sin 30}$

$= 1.73 / \sqrt{3}$ #