NO.: Date:

第十九章：棱镜和透镜（2003年－2017年）

选择题：

① $n_{21} = \frac{n_2}{n_{镜}} \times \frac{n_{镜}}{n_1}$

$\frac{n_2}{n_1} = \frac{\sin\frac{A}{2}}{\sin\frac{\delta_{min}+A}{2}} \times \frac{\sin\frac{\delta_{min}+A}{2}}{\sin\frac{A}{2}}$

$\frac{n_2}{\sqrt{2}} = \frac{\sin\left(\frac{30+60}{2}\right)}{\sin\left(\frac{14+60}{2}\right)}$

$n_2 = 1.66$ #

B.

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

$\frac{1}{-10} + \frac{1}{6} = \frac{1}{f}$

$f = +15\,cm$ #

D.

③ D.

④ $n = \frac{\sin i}{\sin r}$

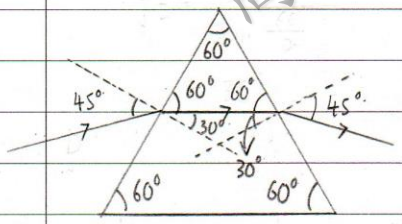
$n = \frac{\sin(r+d)}{\sin r}$

$1.5 = \frac{\sin(40+d)}{\sin 40}$

$d = 34.6°$

B

⑤ 问题中没有说明这是最小的偏向角，所以不能直接采用方程式 $n = \frac{\sin\left(\frac{\delta_{min}+A}{2}\right)}{\sin\left(\frac{A}{2}\right)}$。



$\delta = i_1 + i_2 - A$

$\delta_{min} = 2i - A$

$= 2\times45 - 60$

$= 30°$

式

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

$\sqrt{2} = \frac{\sin 45}{\sin r}$

$r = 30°$

$n = \frac{\sin\left(\frac{\delta_{min}+A}{2}\right)}{\sin\left(\frac{A}{2}\right)}$

$\sqrt{2} = \frac{\sin\left(\frac{\delta_{min}+60}{2}\right)}{\sin\left(\frac{60}{2}\right)}$

$\delta_{min} = 30°$

⑥ $\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$ 要在光屏上形成2个像 $b^2-4ac > 0$

$\frac{1}{u} + \frac{1}{\ell-u} = \frac{1}{f}$ $(-\ell)^2 - 4(1)(f\ell) > 0$

$\frac{\ell-u+u}{u\ell-u^2} = \frac{1}{f}$ $\ell(\ell-4f) > 0$

$u^2 - \ell u + f\ell = 0$ $\ell > 0$ $\ell > 4f$.

A $20\,cm > f$.

⑦ $\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$

$4 + 0 = \frac{1}{f}$

$f = 0.25\,m / 25\,cm$ #

D.

⑧ $\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$ $u + v = 80$

$\frac{1}{80-v} + \frac{1}{v} = \frac{1}{20}$ $u = 80 - v$

$\frac{v+80-v}{80v-v^2} = \frac{1}{20}$

$1600 = 80v - v^2$ $m = \left|\frac{v}{u}\right|$

$v^2 - 80v + 1600 = 0$ $= \left|\frac{40}{40}\right|$

$v = 40\,cm$ $= 1$ #

C

⑨ $n_{gc} = \frac{1}{\sin c}$ $n_{gc} = \frac{\sin i_c}{\sin i_g}$

$\frac{1.8}{1.2} = \frac{1}{\sin c}$ $\frac{1.8}{1.2} = \frac{\sin i_c}{\sin 18.2}$

$c = 41.81°$ $i_c = 27.9°$ #

D.

⑩ $b^2 - 4ac = 0$. → $\ell = 0$ $\ell - 4f = 0$

$(-\ell)^2 - 4(1)(f\ell) = 0$ $\ell = 4f$

$\ell(\ell - 4f) = 0$

C.

⑪ $\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$ $m = \left|\frac{v}{u}\right|$

$\frac{1}{5f} + \frac{1}{v} = \frac{1}{f}$ $\frac{h_i}{h_o} = \left|\frac{5f}{4} \times \frac{1}{5f}\right|$

$\frac{1}{v} = \frac{1}{f} - \frac{1}{5f}$ $= \frac{1}{4}$ #

$\frac{1}{v} = \frac{5-1}{5f}$

$v = \frac{5f}{4}$

B

(12) D

(13) D

(14) D

(15) $m = \left|\frac{V}{u}\right|$ $\quad \frac{1}{u} + \frac{1}{V} = \frac{1}{f}$

$\frac{1}{3} = \frac{-V}{24}$ $\quad \frac{1}{24} - \frac{1}{8} = \frac{1}{f}$

$V = -8\,mm$ $\quad f = -12\,mm$ #

D

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

$1.53 = \frac{1}{\sin C}$ $\quad 1.53 = \frac{\sin i}{\sin 29.19}$

$C = 40.81°$ $\quad i = 48.3°$ #

D

(17) $m = \left|\frac{V}{u}\right|$ $\quad \frac{1}{u} + \frac{1}{V} = \frac{1}{f}$

$\frac{1}{4} = \frac{-V}{u}$ $\quad \frac{1}{u} - \frac{4}{u} = \frac{1}{f}$

$V = -\frac{u}{4}$ $\quad -\frac{3}{u} = \frac{1}{f}$

$u = -3f$

C

(18) $n = \frac{\sin\frac{\delta_{min} + A}{2}}{\sin\frac{A}{2}}$

$\frac{n_{镜}}{n_{水}} = \frac{\sin\frac{\delta_{min} + A}{2}}{\sin\frac{A}{2}}$

$\frac{1.6}{\frac{4}{3}} = \frac{\sin\frac{\delta_{min} + 60}{2}}{\sin\frac{60}{2}}$

$\delta_{min} = 13.7°$ #

B

作答题：

① (a) (i) $\frac{1}{u} + \frac{1}{V} = \frac{1}{f}$ $\quad \left|\frac{V}{u}\right| = \frac{h_i}{h_o}$

$\frac{1}{30} + \frac{1}{V} = \frac{1}{20}$ $\quad \frac{60}{30} = \frac{h_i}{3}$

$V = 60\,cm$ $\quad h_i = 6\,cm$ #

∴ 成像的高度为 6cm，此像是倒立的。

(ii) $\frac{1}{u} + \frac{1}{V} = \frac{1}{f}$ $\quad$ 成像的长度

$\frac{1}{27} + \frac{1}{V} = \frac{1}{20}$ $\quad = 77.14\,cm - 60\,cm$

$V = 77.14\,cm$ $\quad = 7.14\,cm$ #

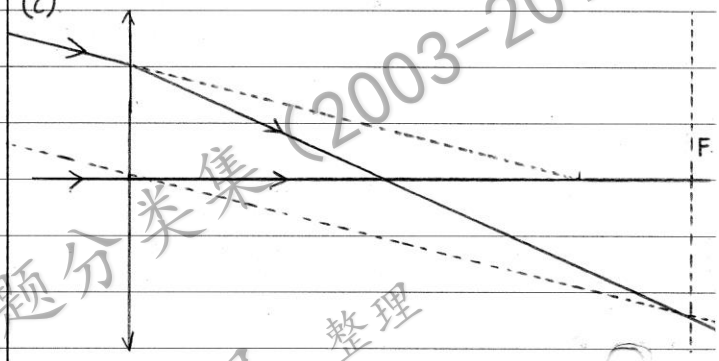
(b) $\frac{1}{u} + \frac{1}{V} = \frac{1}{f}$ $\quad m = \left|\frac{V}{u}\right|$

$\frac{1}{-12} + \frac{1}{V} = \frac{1}{15}$ $\quad = \left|\frac{6.67}{-12}\right|$

$V = 6.67\,cm$ # $\quad = 0.56$ #

∴ 成像为正立缩小的实像

(c)



② (a) (i) $n = \frac{\sin i}{\sin r}$ $\quad n = \frac{\sin i_2}{\sin r_2}$

$1.565 = \frac{\sin 22}{\sin r}$ $\quad 1.565 = \frac{\sin i_2}{\sin 31.15}$

$r = 13.85°$ $\quad i_2 = 54.05°$ #

(ii) $D = (22° - 13.85°) + (54.05° - 31.15°)$

$= 31.05°$ #

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

$1.565 = \frac{1}{\sin C}$ $\quad 1.565 = \frac{\sin i}{\sin 5.28°}$

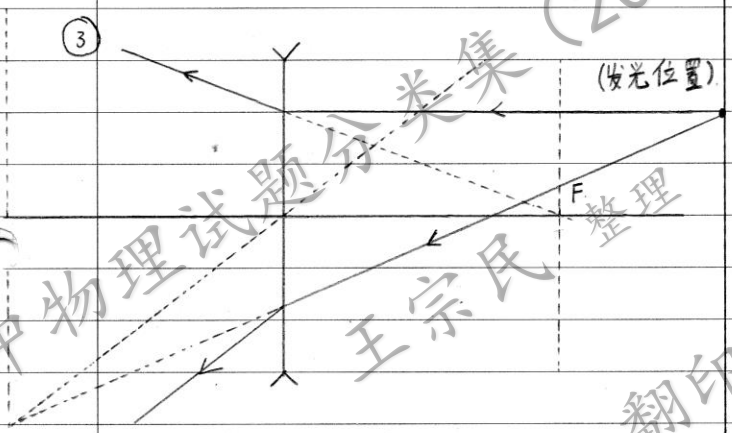
$C = 39.72°$ $\quad i = 8.28$ #

(c) $n = \dfrac{\sin\left(\frac{\delta_{min}+A}{2}\right)}{\sin\left(\frac{A}{2}\right)}$

$1.565 = \dfrac{\sin\left(\frac{\delta_{min}+45}{2}\right)}{\sin\left(\frac{45}{2}\right)}$

$\delta_{min} = 28.58°$ #

③

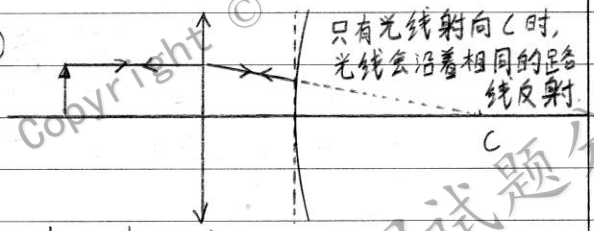


④ (a) $\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$

$0 + 0.083 = \frac{1}{f}$

$f = 12.05\,cm$ #

(b)



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

$\frac{1}{6} + \frac{1}{12} = \frac{1}{f}$

$f = 4\,cm$ #

⑤ (a) $\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$

$\frac{1}{-10} + \frac{1}{v} = \frac{1}{40}$

$v = 8\,cm$ # (实像)

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

$\frac{1}{-3} + \frac{1}{v} = \frac{1}{-30}$

$v = 3.33\,cm$ # (实像)

⑥ (a) $\delta = i_1 + i_2 - A$

$30 = 60 + \alpha - 90$

$\alpha = 60°$

(b) 因 $i_1 = i_2 = 60°$，所以 $r_1 = r_2 = 45°$

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

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

$= 1.225$ #

(c) $n = \frac{c}{v}$ $\qquad v = \frac{s}{t}$

$1.225 = \frac{3\times10^8}{v}$ $\qquad 2.45\times10^8 = \frac{5\div100}{\cos 45 \times t}$

$v = 2.45\times10^8\,ms^{-1}$ $\qquad t = 2.89\times10^{-10}\,s$

(d) AC面：$n = \dfrac{\sin i}{\sin r}$

$1.225 = \dfrac{\sin 90}{\sin r}$

$r = 54.72°$

AB面：$n = \dfrac{\sin i}{\sin r}$

$1.225 = \dfrac{\sin i}{\sin 35.28}$

$i = 45.04°$

⑦ (a) (i) $n = \dfrac{\sin i}{\sin r}$ $\qquad \tan r = \dfrac{2}{20}$

$\frac{4}{3} = \dfrac{\sin i}{\sin 5.71}$ $\qquad r = 5.71°$

$i = 7.62°$

$\tan 7.62° = \dfrac{2}{OB}$

$OB = 14.94\,cm$ #

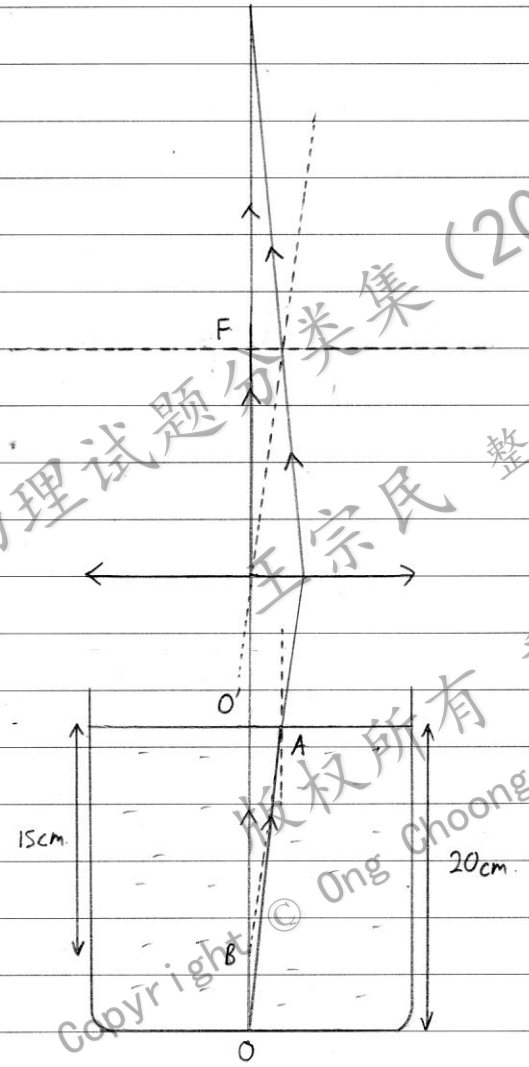
(ii) 入射角 $= 5.71°$；折射角 $= 7.62°$

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

$\frac{1}{10+14.94} + \frac{1}{v} = \frac{1}{15}$

$v = 37.63\,cm$ #

(ii)



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

$\frac{1}{20} + \frac{1}{v} = \frac{1}{15}$

$v = 60\text{cm}$ # (实像).

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

$\frac{1}{-50} + \frac{1}{v} = \frac{1}{10}$

$v = 8.33\text{ cm}$.

∴ 像与透镜的距离 $= 10\text{cm} - 8.33\text{cm}$

$= 1.67\text{ cm}$ #

④ (a)