Solution : DTS

1.(C) Here, $u = -25\ cm, v = -30\ cm$

$\because \quad \frac{1}{v} - \frac{1}{u} = \frac{1}{f}$ or $\frac{1}{-30} + \frac{1}{25} = \frac{1}{f} \qquad \therefore \quad f = 150\ cm = \frac{150}{100}\ m$

$\therefore$ Power of lens $= \frac{1}{f} = \frac{100}{150} = \frac{2}{3} D$

2.(B) According to mirror formula,

$\because \quad \frac{1}{v} - \frac{1}{u} = \frac{1}{f}$ or $-\frac{1}{180} + \frac{1}{d} = \frac{1}{150}$

or $\frac{1}{d} = \frac{1}{180} + \frac{1}{150} = \frac{5+6}{900} \qquad \therefore \quad d = \frac{900}{11}\ cm = 81.82\ cm$

3.(C) Objective of compound microscope is a convex lens. Convex lens form real and enlarged image, when an object is placed between its focus and lens.

4.(B)

5.(A) $\theta = \frac{l}{r}$, where $\theta = 1$ minute

So, $\theta = \frac{1}{60°} = \left(\frac{\pi}{180} \times \frac{1}{60}\right)$ rad and $l = 3$ m

$\therefore \quad x = r = \frac{l}{\theta} = \frac{3m}{\left(\frac{\pi}{180} \times \frac{1}{60}\right)} \approx 10\ km$

6.(A) In Ramsden's eye-piece, the distance between the two lenses is (2/3)*f*, where *f* is focal length of each lens used. The cross-wire is at a distance *f*/4 from objective lens. Hence, the distance of cross-wire from eye lens $= \frac{2}{3} f + \frac{f}{4} = \frac{11f}{12} = \frac{11 \times 1.2}{12} = 1.1 cm$

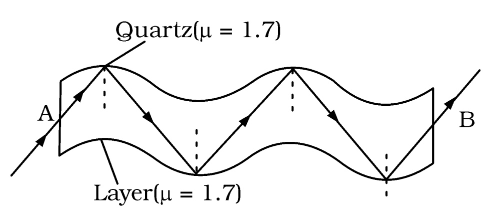
7.(A) $(f_0 / f_e) = 10,\ f = 2cm$

$L = f_0 + f_e + 4f = 96$

Solving, we get : $f_o = 80\ cm, f_e = 8cm$

8.(A) Fact

9.(D) An optical fibres is a device based on total internal reflection by which at light signal can be transferred from one place to the other with a negligible loss of energy.



10.(D) Optical fibre is made of a thin glass core (diameter 10 to 100 μm) surrounded by a glass coating called cladding is protected by a jacket of plastic.

The refractive index of the glass used for making core $(n_1 = 1.7)$ is a little more than the refractive index of the glass (n_2 = 1.5) used for making the cladding i.e., $n_1 > n_2$

11.(A) For eyepiece $= \frac{1}{-25} - \frac{1}{u_e} = \frac{1}{5}$

$\therefore \quad m_e = \frac{v_e}{u_e} = -\frac{25}{-25/6} = 6$

For objective, $v = L - |u_e|$ $\quad \therefore \quad v = \frac{125}{6} - \frac{25}{6} = \frac{100}{6}$

It object is at distance u from objective.

$\therefore \quad \frac{1}{v} - \frac{1}{u} = \frac{1}{1}$ or $\frac{6}{100} - \frac{1}{u} = 1$ $\quad \therefore \quad -\frac{1}{u} = 1 - \frac{6}{100} = \frac{94}{100}$

$\therefore \quad u = -\frac{100}{94}$ $\quad \therefore \quad m_0 = \frac{v}{u} = \frac{\frac{100}{6}}{-\frac{100}{94}} = -\frac{94}{6}$

12.(C) Total magnification, $m = m_0 m_e = 6 \times \left(-\frac{94}{6}\right) = -94$

13.(A) RP of a telescope $= \frac{D}{1.22\lambda}$

Where, D is the diameter of the objective lens and λ is the wavelength of light used.

$\therefore \quad RP \propto D$

14.(B) Resolving power of telescope, $RP = \frac{d}{1.22\,\lambda}$

15.(A)

Solution : JEE Main (Archive)

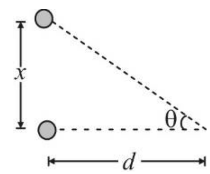
1.(D) Resolving power is inversely proportional to wavelength of the light

2.(B) Large aperture leads to high resolving power of telescope.

3.(C) The image formed by an objective of compound microscope is real and enlarged.

4.(C) Resolving limit $R.L = \dfrac{1.22\lambda}{a}$

Again resolving limit from figure.



$$R.L. = \frac{x}{d} \Rightarrow d = \frac{x}{RL}$$

$$\Rightarrow \quad d = \frac{x \times a}{1.22\lambda} = \frac{1 \times 10^{-3} \times 3 \times 10^{-3}}{1.22 \times 500 \times 10^{-9}} = 5m$$

5.(A)

6.(C) The resolving power of microscope

$$R.P. = \frac{n \sin 2\beta}{1.22\lambda}$$

7.(D) $\dfrac{1}{v} - \dfrac{1}{u} = \dfrac{1}{f}$; $\dfrac{1}{v} - \dfrac{1}{-1.25} = \dfrac{1}{1.2}$ $\therefore$ $v = +30\,cm$

Magnifying power of compound microscope, when the final image is formed at infinity

$m = \dfrac{v}{u}\dfrac{D}{f_e}$; $|m| = \dfrac{30}{1.25} \times \dfrac{25}{3}$; $|m| = 200$

8.(D) For a Galilean telescope,

$f_0 = +30\,cm, f_e = -3cm$

Magnifying power of Galilean telescope for the final image formed at least distance of clear vision is

$$m = -\frac{f_0}{f_e}\left(1 + \frac{f_e}{D}\right) = \frac{-30}{-3}\left(1 - \frac{3}{25}\right) = 10 \times \frac{22}{25} = +8.8$$

9.(A) $\theta = 1.22\dfrac{\lambda}{D}$

Minimum separation $= (25 \times 10^{-2})\theta = 30\,\mu m$

10.(A) The size of image formed by the objective lens is

$$h = \frac{50}{1000} \times 150 = 7.5\,cm$$

In normal setting, the angle formed by the image of the tower is 'θ' $\therefore$ $\tan\theta = \dfrac{h}{fe} = \dfrac{7.5}{5} = 1.5$

$\tan\theta = 1.5$ $\therefore$ θ is close to $60°$

11.(D) Telescope resolves and brings objects closer. Hence, telescope with magnifying power of 20, the tree appears 20 times nearer.

12.(B) $\lambda = \dfrac{h}{mV} = \dfrac{h}{\sqrt{2mE}} = \dfrac{12.27}{\sqrt{V}}\mathring{A} \Rightarrow 0.075 = \dfrac{12.27}{\sqrt{V}}$

$\Rightarrow \sqrt{V} = \frac{12270}{75}$

$\Rightarrow V = (164)^2 = 26896 = 26kV$ $\therefore E \sim 25keV$

13.(B) $\frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{R}$

$\frac{1.34}{v} - \frac{1}{-\infty} = \frac{1.34-1}{7.8}$

$\frac{1.34}{v} = \frac{34}{780} \Rightarrow v = 30.74\,mm$

$v = 3.1\,cm$

14.(A) Limit of resolution $= 1.22\frac{\lambda}{D}$

$= \frac{1.22 \times 500 \times 10^{-9}}{200 \times 10^{-2}} = 305 \times 10^{-9}$ rad.

15.(D) Limit of resolution $= \frac{1.22\lambda}{d}$

$= \frac{1.22 \times 600 \times 10^{-9}}{250 \times 10^{-2}}$; $= 2.9 \times 10^{-7}\,rad$

16.(A) $R \cdot P = \frac{0.61\lambda}{\mu \sin\theta} = 0.61 \times \frac{\lambda}{N.A.}$

$N.A = \mu \sin\theta = 1.25$ **;** $R.P = 0.61 \times \frac{5 \times 10^{-7}}{1.25} = 0.24\ \mu m$

17.(D) $m = \frac{L}{f_0}\left(1 + \frac{D}{f_e}\right)$, if final image is least distance of distinct vision

$\Rightarrow$ $375 = \frac{150}{5}\left(1 + \frac{25}{f_e}\right)$; $f_e = \frac{750}{345} = 2.17\ cm = 21.7\ mm \approx 22\ mm$

Also, $m = \frac{L}{f_0}\left(\frac{D}{f_e}\right)$ if final image is at infinity. $\Rightarrow$ $375 = \frac{150}{5}\left(\frac{25}{f_e}\right)$, $f_e = 22\ mm$

18.(A) $\Delta l_{\min} = r \times \Delta\theta_{\min}$

$= 4 \times 10^8 \times \frac{1.22 \times 5500 \times 10^{-10}}{5} = 53.68\,m$

Hence Δl is close to 60 m

19.(C) $f_0 + f_e = 60$; $\frac{f_0}{f_e} = 5$

$\frac{60 - f_e}{f_e} = 5$; $f_e = 10\ cm$

20.(6.25) $m = \frac{L}{f_0}\left(1 + \frac{D}{f_e}\right)$

$$100 = \frac{20}{1}\left(1 + \frac{25}{f_e}\right)$$

$$4 = \frac{25}{f_e}; f_e = \frac{25}{4} = 6.25 \text{ cm}$$

21.(50) Final image should be at ∞ for normal adjustment (Minimum strain)

So the image formed by the objective lens must be at the focus of eye piece.

For objective lens:

$$\frac{1}{v_0} - \frac{1}{u_0} = \frac{1}{f_0}$$

$$v_0 = 10 - 5 = 5cm$$

$$\frac{1}{5} - \frac{1}{u_0} = \frac{1}{1} \quad ; \quad |u| = \frac{5}{4}cm \quad ; \quad \frac{n}{40} = \frac{5}{4}$$

$$n = 50$$