RAY OPTICS
PREVIOUS EAMCET BITS
(ENGINEERING)

1. The two lenses of an achromatic doublet should have : **[EAMCET 2009 E]**
   1) equal powers
   2) equal dispersive powers
   3) equal ratio of their power and dispersive power
   4) sum of the products of their power and dispersive power should be equal to zero
   Ans : 4

Sol. The condition for an achromatic doublet is $\frac{\omega_1}{f_1} + \frac{\omega_2}{f_2} = 0 \Rightarrow \omega_1 p_1 + \omega_2 p_2 = 0$

Since focal length = $\frac{1}{focal \quad power}$

2. **Statement (S) :** Using Huygen's eye piece measurements can be taken but tare not correct
Reason (R) : The cross wires, scale and final image are not magnified proportionately because the image of the object is magnified by two lenses, whereas the cross wire scale is magnified by one lens only.
   Identify the correct one of the following : **[EAMCET 2008 E]**
   1) Both S and R are true, R explains S
   2) Both S and R are true but R cannot explain S
   3) only S is correct, but R is wrong
   4) Both S and R are wrong
   Ans : 1

Sol. Huygen eye piece is not mainly used for measurement. Therefore both statement and Reason are correct.

3. The refractive index of a material of a plano concave lens is 5/3, the radius of curvature is 0.3m. The focal length of the lens in air is **[EAMCET 2008 E]**
   1) $-0.45\,\text{m}$ 2) – 0.6 m 3) – 0.75 m 4) –1.0 m
   Ans: 1

Sol. From lens makers formula, for plano concave lens

$$\frac{1}{F} = -(\mu - 1)\left[\frac{1}{R}\right]$$

$$\frac{1}{F} = -\left(\frac{5}{3} - 1\right)\left[\frac{1}{0.3}\right]$$

$$\therefore \text{ F} - 0.45 \text{ m}$$

4. An achromatic combination of lenses produces **[EAMCET 2008 E]**
   1) Images in black and white
   2) Coloured images
   3) Images unaffected by variation of refractive index with wave length
   4) Highly enlarged images are formed
   Ans: 3

Sol. Images in Achromatic Combination of lens are independent of variation of refractive index with wavelength .

5. Match the following : **[EAMCET 2007 E]**

List – I	List – II
1) Burning candle	i) Line spectrum

2) Sodium vapour — ii) Continuous spectrum
3) Bunsen flame — iii) Band spectrum
4) Dark lines in solar spectrum — iv) Absorption spectrum

1) $1-\text{iii}, 2-\text{i}, 3-\text{ii}, 4-\text{iv}$ 2) $1-\text{iii}, 2-\text{ii}, 3-\text{i}, 4-\text{iv}$
3) $1-\text{ii}, 2-\text{ii}, 3-\text{i}, 4-\text{iv}$ 4) $1-\text{ii}, 2-\text{i}, 3-\text{iii}, 4-\text{iv}$

Ans: 4

Sol. 1) Burning candle, incandescent lamp are the examples of continuos spectrum
2) Sodium vapour is example of line spectrum
3) Bunsen flame is example of band spectrum
4) Dark lines in solar spectrum called as Fraunhoffer lines are due to absorption spectrum.

6. The refractive index of the material of a double convex lens is 1.5 and its focal length is 5 cm. If the radius of curvature ar equal, the value of the radius of curvature (in cm) is **[EAMCET 2007E]**

1) 5.0 2) 6.5 3) 8.0 4) 9.5

Ans: 1

Sol. The lens makers formula for thin lens is $\frac{1}{F} = (\mu - 1)\left[\frac{1}{R_1} + \frac{1}{R_2}\right]$

But given $R_1 = R_2 = R$ [double convex]

$\frac{1}{5} = (1.5 - 1)\left[\frac{2}{R}\right] \Rightarrow R = 5\text{cm}$

7. In Ramsden eyepiece, the two planoconvex lenses each of focal length f are separated by a distance 12 cm. The equivalent focal length (in cm) of the eyepiece **[EAMCET 2007 E]**

1) 10.5 2) 12.0 3) 13.5 4) 15.5

Ans : 3

Sol. The distance between two plano convex lens in Ramsden eye piece is $d = \frac{2f}{3} \Rightarrow f = \frac{3d}{2}$

$\therefore$ f = 18 cm

$\therefore$ Equivalent focal length of the eye piece = $\frac{3f}{4} = 13.5\text{cm}$

8. In Huygen's eyepiece
1) The cross wires are outside the eye piece
2) Condition for achromoatism is satisfied
3) Condition for minimum spherical aberration is not satisfied
4) The image formed by the objective is a virtual image

Ans: 2

Sol: In Huygens eyepiece both spherical an chromatic aberration are eliminated, since the distance between the lenses is 2f.

9. The two surfaces of a biconvex lens has same radii of curvatures. This lens is made of glass of refractive index 1.5 and has a focal length 10 cm in air. The lens is cut into two equal halves along a plane perpendicular to its principal axis to yield two planoconvex lenses. The two pieces are glued such that the convex surface touch each other. If this combination lens is immersed in water (refractive index = 4/3), its focal length (in cm) is **[EAMCET 2006 E]**

1) 5 2) 10 3) 20 4) 40

Ans: 4

Sol. Let F is the focal length of a biconvex lens, if the lens is cut into two equal parts to yield two plano-convex lenses then the focal length of two parts is 2 F each.
When they are kept in contact, then effective focal length of combination is

$$\frac{1}{f}=\frac{1}{f_1}+\frac{1}{f_2}=\frac{1}{2F}+\frac{1}{2F}=\frac{1}{F}$$

$\therefore$ f = F (i.e) no change in focal length let F_ω is the focal length of lens in water

$$\therefore\ \frac{1}{F_{air}}=\left(\mu_g-1\right)\left[\frac{1}{R_1}+\frac{1}{R_2}\right]\ldots\ldots\ldots\ldots(1)$$

$$\frac{1}{F_{water}}=\left(\frac{\mu_g}{\mu_\omega}-1\right)\left[\frac{1}{R_1}+\frac{1}{R_2}\right]\ldots\ldots\ldots\ldots..(2)$$

Dividing (1) and (2)

$$\frac{F_\omega}{F_a}=\frac{\mu_\omega\left[\mu_g-1\right]}{\left(\mu_g-\mu_\omega\right)}=\frac{\frac{4}{3}\left[\frac{3}{2}-1\right]}{\left(\frac{3}{2}-\frac{4}{3}\right)}=4$$

$\therefore\ F_{water}$ = 4 x 10 = 40 cm

10. Dispersive power depends on the following: **[EAMCET 2006 E]**
1) material of the prism
2) shape of the prism
3) size of the prism
4) size, shape and material of the prism
Ans: 1

Sol. Dispersive power is the characteristic property of material.
Therefore it depends on the material of prism

11. Match the appropriate pairs from Lists I and II **[EAMCET 2006 E]**

List – I	List - II
a) Nitrogen molecules	e) Continuous spectrum
b) Incandescent solids	f) Absorption spectrum
c) Fraunhofer lines	g) Band spectrum
d) Electric arc between iron rods	h) Emission spectrum

1) $a-g, b-e, c-f, d-h$
2) $a-f, b-e, c-h, d-g$
3) $a-h, b-e, c-f, d-g$
4) $a-e, b-g, c-h, d-f$
Ans: 1

Sol.

12. **Assertion (A) :** Propagation of light through an optical fibre is due to total internal reflection taking place at the core-clad interface.
Reason (R) : Refractive index of the material of the core of the optical fibre is greater than that of air. **[EAMCET 2005 E]**
1) Both A and R are true and R is the correct explanation of A
2) Both A and R are true and R is not the correct explanation of A
3) A is true but R is false
4) A is false but R is true
Ans: 2

Sol. The condition for total internal reflection which takes place in optical fibre is due to
i) Light travels from denser medium to rarer medium
ii) Angle of incidence should be greater than critical angle

13. The focal length of an equi-convex lens is greater than the radius of curvature of any of the surfaces. Then the refractive index of the material of the lens is **[EAMCET 2005 E]**
1) greater than zero but less than 1.5 2) greater than 1.5 but less than 2.0
3) greater than 2.0 but less than 2.5 4) greater than 2.5 but less than 3.0
Ans: 1

Sol. Lens makers formula for equi-convex lens is

$$\frac{1}{F} = (\mu - 1)\left(\frac{2}{R}\right)$$

$$\Rightarrow F = \frac{R}{2[\mu - 1]}$$

If F < R, So 2(μ –1) < 1

Therefore $(\mu - 1) < \frac{1}{2}$ or $\mu < 1.5$

As focal length of convex lens is positive.

So, μ cannot be negative, hence μ should be greater than zero but less than 1.5

14. Fraunhoffer lines are produced by the absorption of light in **[EAMCET 2005 E]**
1) The chromosphere of the Sun 2) The photosphere of the Sun
3) The atmosphere of the Earth 4) The ionosphere of the Earth
Ans: 1

Sol. Fraunhoffer lines are produced by the absorption of light in the chromosphere of sun.

15. **Assertion (A) :** Optical fibres are widely used in communication network.
Reason (R) : Optical fibres are small in size, light weight, flexible and there is no scope for interference in them. **[EAMCET 2004 E]**
1) Both A and R are true and R is the correct explanation of A
2) Both A and R are true and R is not the correct explanation of A
3) A is true but R is false
4) A is false but R is true
Ans: 1

Sol. Optical fibres are used in communication network because there is no loss of energy

16. The refraction angle of a prism is A and the refractive index of the material of the prism is cot(A/2). The angle of minimum deviation of the prism is : **[EAMCET 2004 E]**

1) $\pi + 2A$ 2) $\pi - 2A$ 3) $\frac{\pi}{2} + A$ 4) $\frac{\pi}{2} - A$

Ans: 2

Sol. From Snells law $\mu = \dfrac{\sin\left(\dfrac{A+d}{2}\right)}{\sin\left(\dfrac{A}{2}\right)}$

But given that $\mu = \cot\left(\dfrac{A}{2}\right)$

$$\therefore \cot\left(\frac{A}{2}\right) = \frac{\sin\left(\frac{A+d}{2}\right)}{\sin\left(\frac{A}{2}\right)} \text{ (or) } \frac{\cos\left(\frac{A}{2}\right)}{\sin\left(\frac{A}{2}\right)} = \frac{\sin\left(\frac{A+d}{2}\right)}{\sin\left(\frac{A}{2}\right)}$$

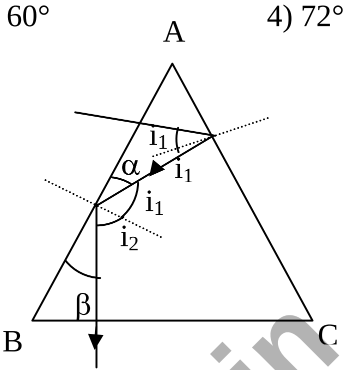
(or) $\sin\left(90^\circ-\frac{A}{2}\right)=\sin\left(\frac{A+d}{2}\right)$ (or) $90^\circ-\frac{A}{2}=\frac{A+d}{2}$

$\Rightarrow d=180^\circ-2A$

17. The principal section of a glass prism is an isosceles triangle ABC will AB =AC. The face AC is silvered. A ray of light is incident normally on the face AB and after two reflections, it emerges from the base BC perpendicular to the base. Angule BAC of the prism is **[EAMCET 2004 E]**

1) 30° 2) 36° 3) 60° 4) 72°

Ans: 2



Sol. From the figure $i_1=90^\circ-(90^\circ-A)=A$

and $\alpha=90^\circ-2i_1=90^\circ-2A$

$\therefore\ i_2=90^\circ-\alpha=90^\circ-(90^\circ-2A)=2A$

$\therefore\ \beta=90^\circ-i_2=90^\circ-2A$

From the geometry of the figure

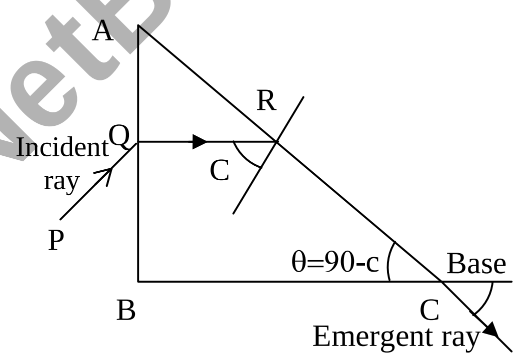
$A+2A+2A=180^\circ$

$\therefore$ A = 36°

18. A ray of light is incident on the hypotenuse of a right-angled prism after travelling parallel to the base inside the prism. If μ is the refractive index of the material of the prism, the maximum value of the base angle for which light is totally reflected from the hypotenuse is **[EAMCET 2003 E]**

1) $\sin^{-1}\left(\frac{1}{\mu}\right)$ 2) $\tan^{-1}\left(\frac{1}{\mu}\right)$ 3) $\sin^{-1}\left(\frac{\mu-1}{\mu}\right)$ 4) $\cos^{-1}\left(\frac{1}{\mu}\right)$

Ans: 4



Sol. Angle made by the emergent ray RS with base is BC or QR = 90°- C

But $\mu=\frac{1}{\sin c}=\frac{1}{\cos(90-c)}=\frac{1}{\cos\theta}$

$\therefore\ \cos\theta=\frac{1}{\mu}$

$\Rightarrow \theta=\cos^{-1}\left(\frac{1}{\mu}\right)$ S

19. A prism of refractive index μ and angle A is placed in the minimum deviation position. If the angle of minimum deviation is A, then the value of A in terms of μ is **[EAMCET 2003 E]**

1) $2\cos^{-1}(\mu)$ 2) $2\sin^{-1}(\mu)$ 3) $2\cos^{-1}\left(\frac{\mu}{2}\right)$ 4) $2\sin^{-1}\left(\frac{\mu}{2}\right)$

Ans: 3

From Snell's law in the minimum deviation position for prism

$$\mu=\frac{\sin\left(\frac{A+d}{2}\right)}{\sin\left(\frac{A}{2}\right)}$$

given that d = A

$$\mu = \frac{\sin\left(\frac{A+A}{2}\right)}{\sin\left(\frac{A}{2}\right)} = \frac{\sin A}{\sin\left(\frac{A}{2}\right)} = \frac{2\sin\left(\frac{A}{2}\right)\cos\left(\frac{A}{2}\right)}{\sin\left(\frac{A}{2}\right)}$$

$$\mu = 2\cos\left(\frac{A}{2}\right)$$

on simplifying $A = 2\cos^{-1}\left(\frac{\mu}{2}\right)$

20. A convex lens of focal length 0.15 m is made of a material of refractive index 3/2. When it is placed in a liquid, its focal length is increased by 0.225m. The refractive index of the liquid is **[EAMCET 2002 E]**

1) $\frac{7}{4}$ 2) $\frac{5}{4}$ 3) $\frac{9}{4}$ 4) $\frac{3}{2}$

Ans: 2

Sol: We know $\frac{f_{liq}}{f_{air}} = \frac{(\mu_g - 1)\mu_\ell}{(\mu_g - \mu_\ell)}$

$\therefore \frac{0.15 + 0.225}{0.15} = \frac{(3/2 - 1)\mu_\ell}{(3/2 - \mu_\ell)}$

Solving the above equation, we get $\mu_\ell = \frac{5}{4}$

21. A prism is made up of material of refractive index $\sqrt{3}$. The angle of the prism is A°. If the angle of minimum deviation is equal to the angle of the prism, then the value of A is **[EAMCET 2002 E]**

1) 30° 2) 45° 3) 60° 4) 75°

Ans: 3

Sol: $\mu_\ell = \frac{\sin\frac{A + D_m}{2}}{\sin(A/2)}$

But A = D_m (given)

$\therefore\ \mu_\ell = \frac{\sin A}{\sin(A/2)} = \frac{2\sin A/2\cos A/2}{\sin A/2}$

$\Rightarrow \mu = \sqrt{3} = 2\cos A/2$

$\Rightarrow \cos A/2 = \sqrt{3}/2$

$\Rightarrow A/2 = 30°$ $\quad\therefore$ A = 60°

22. In the visible region the dispersive powers and the mean angular deviations for crown and flint glass prism ω, ω' are d, d' respectively. The condition for getting dispersion with zero deviation, when the two prisms are combined is **[EAMCET 2001 E]**

1) $\sqrt{\omega d} + \sqrt{\omega' d'} = 0$ 2) $\omega' d +, \omega d' = 0$

3) $\omega d + \omega' d' = 0$ 4) $(\omega d)^2 + (\omega' d')^2 = 0$

Ans: 3

Sol: The condition for getting dispersion without deviation when two prisms are combined is $\omega d + \omega' d' = 0$ which is called as condition for achromatism

23. One face of the glass prism is silver polished. A light ray falls at an angle of 45° on the other face. After reflection it is subsequently reflected from the silvered face and then retraces its path. The refracting angle of the prism is 30°. The refractive index of the prism is **[2001 E]**

1) $\frac{3}{2}$ 2) $\sqrt{2}$ 3) $\frac{\sqrt{3}}{2}$ 4) $\sqrt{3}$

Ans: 2

Sol: Angle of incidence (i) = 45°

$r_1 + r_2 = A = 30°$

$\therefore \ \mu = \frac{\sin i}{\sin r}$ [from Snell's law]

When the ray of light retraces its path at the silvered face, the angle of refraction becomes 30°.

$\therefore \ \mu = \frac{\sin i}{\sin r} = \frac{1/\sqrt{2}}{1/2} = \sqrt{2}$

24. When a glass prism of refracting angle 60° is immersed in a liquid its angle of minimum deviation is 30°. The critical angle of glass with respect to the liquid medium is **[2001 E]**

1) 42° 2) 45° 3) 50° 4) 52°

Ans: 2

Sol: We know A = 60° and D_m = 30°

If C is critical angle then $\mu = \sqrt{2}$ we know that $\mu = \frac{1}{\sin c}$

$\sin C = \frac{1}{\mu} = \frac{1}{\sqrt{2}} \Rightarrow C = 45°$

25. In a compound microscope crosswires are fixed at the point : **[EAMCET 2000E]**

1) Where the image is formed by the objective
2) Where the image is formed by the eye –piece
3) Where the focal point of the objective lies
4) Where the focal point of the eye-piece lies

Ans: 1

Sol: Crosswires in a compound microscope are fixed at the same point where the image due to the objective is formed.

26. Consider the following two statements A and B identify the correct choice in the given answer

A: Line spectra is due to atoms in gaseous state

B **:** Band spectra is due to molecules. **[EAMCET 2000 E]**

1) Both A and B are false 2) A is true and B is false
3) A is false and B is true 4) Both A and B are true

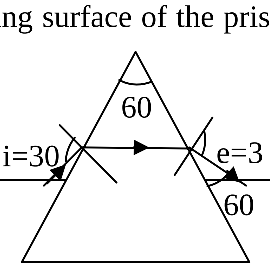
Ans: 4

Sol: Band spectrum is formed by gases which are in molecular state. It is also called as molecular spectrum.

Line spectrum is formed by gases which are in atomic state. It is also called as atomic spectrum.

27. Under minimum deviation condition in a prism, if a ray is incident at an angle 30°, the angle between the emergent ray and the second refracting surface of the prism is : (Angle of the prism = 60°) **[EAMCET 2000 E]**

1) 0°
2) 30°



3) 45°
4) 60°
Ans: 4

Sol: At minimum deviation position of a prism, angle of incidence and angle of emergence are equal.
$\Rightarrow i = e = 30°$
$\therefore$ The angle between the emergent ray and the second refracting surface will be
$90° - e = 90° - 30° = 60°$

28. The focal length of the lenses of an astronomical telescope are 50 cm and 5 cm. The length of the telescope when the image is formed at the least distance of distinct vision is **[EAMCET 2000E]**
1) 45 cm 2) 55 cm 3) 275/6 m 4) 325/6 cm
Ans: 4

Sol: $f_0 = 50$ cm $f_e = 5$ cm
When the final image is formed at least distance of distinct vision, it length
$L = f_0 + u_e$
But $u_e = \frac{v_e f_e}{v_e + f_e} = \frac{(25)(5)}{(30)} = \frac{25}{6}$ cm
$\therefore L = 50 + \frac{25}{6} = \frac{325}{6}$ cm

MEDICAL

29. A glass slab of thickness 8 cms contains the same number of waves as 10 cm long path of water when both are traversed by the same monochromatic light. If the refractive index of water is 4/3., the refractive index of glass is : **[EAMCET 2009 M]**
1) $\frac{5}{3}$ 2) $\frac{5}{4}$ 3) $\frac{16}{15}$ 4) $\frac{3}{2}$
Ans: 1

Sol: $(\mu_{glass})(8) = (\mu_{water})(10)$
$\Rightarrow \mu_{glass} = \left(\frac{4}{3}\right)\left(\frac{10}{8}\right) = \frac{5}{3}$

30. In Huygen' eye piece **[EAMCET 2008 M]**
1) Chromatic aberration is not eliminated
2) Spherical aberration is completely eliminated
3) Focal length of field lens and eye lens are equal
4) Cross wires cannot be provided
Ans: 2

Sol. In Huygens eyepiece spherical aberration and chromatic aberration are completely eliminated because both the conditions to eliminate them are satisfied

31. Solar spectrum is an example of **[EAMCET 2008 M]**
1) line emission spectrum 2) band absorption spectrum
3) line absorption spectrum 4) continuous emission spectrum
Ans: 3

Sol. Solar spectrum is an example of line absorption spectrum since dark lines are observed

32. In Ramsden's eyepiece the focal length of each lens is F. The distance of the image formed by the objective lens from the eye lens is **[EAMCET 2007 M]**

1) $\frac{14F}{15}$ 2) $\frac{13F}{14}$ 3) $\frac{12F}{13}$ 4) $\frac{11F}{12}$

Ans: 4

Sol. The distance of image formed by the object lens from the eye lens $=\frac{2F}{3}+\frac{F}{4}=\frac{11F}{12}$

33. The velocities of light in two different mediums are $2\times10^8\,ms^{-1}$ and $2.5\times10^8\,ms^{-1}$ respectively. The critical angle for these medium is **[EAMCET 2007 M]**

1) $\sin^{-1}\left(\frac{1}{5}\right)$ 2) $\sin^{-1}\left(\frac{4}{5}\right)$ 3) $\sin^{-1}\left(\frac{1}{2}\right)$ 4) $\sin^{-1}\left(\frac{1}{4}\right)$

Ans: 2

Sol. If c is the critical angle

$$\sin c=\frac{\text{velocity of light in medium}}{\text{velocity of light in vaccum}}$$

$$=\frac{\text{velocity of light in denser medium}}{\text{velocity of light in rarer medium}}$$

$$\therefore\ \sin c=\frac{2\times10^8}{2.5\times10^8}=\frac{4}{5}$$

$$\therefore\ c=\sin^{-1}\left(\frac{4}{5}\right)$$

34. A diverging meniscus lens of 1.5 refractive index has concave surfaces of radii 3 and 4 cm. The position of the image if an object is placed 12 cm in front of the lens is **[EAMCET 2007 M]**

1) 7 cm 2) –8 cm 3) 9 cm 4) 10 cm

Ans: 2

Sol. Lens makers formula for a lens is $\frac{1}{F}=(\mu-1)\left[\frac{1}{R_1}-\frac{1}{R_2}\right]$

$R_1=-3$ cm, $R_2=-4$ cm

$$\frac{1}{F}=(\mu-1)\left[\frac{-1}{3}+\frac{1}{4}\right]=(1.5-1)\left[\frac{-1}{3}+\frac{1}{4}\right]\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

from u, v formula

$$\frac{1}{F}=\frac{1}{u}+\frac{1}{v}\qquad\therefore\ \frac{1}{F}=\frac{1}{v}+\frac{1}{12}\ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(2)$$

comparing (1) and (2)

$$-(1.5-1)\left[-\frac{1}{3}+\frac{1}{4}\right]=\frac{1}{v}+\frac{1}{12}$$

on solving v = -8 cm

35. In Ramsden's eye piece, the two plano convex lenses each of focal length f, are separated by a distance 12 cm. The equivalent focal length (in cm) of the eye lens **[EAMCET 2007 M]**

1) 10.5 2) 12 3) 13.5 4) 15.5

Ans: 3

Sol. The distance between two plano-convex lenses in Ramsden's eyepiece is

$$d=\frac{2f}{3}=12\Rightarrow f=18cm$$

$\therefore$ Equivalent focal length in Ramsdens eyepiece is $\frac{3f}{4} = \frac{3}{4} \times 18 = 13.5\text{cm}$

36. A light ray is travelling between two media as given below. The angle of incidence on the boundary in all the cases is 30°. Identify the correct sequence of increasing order of angles of refraction **[EAMCET 2006 M]**

1) a, b, c 2) b, c, a 3) c, a, b 4) a, c, b

Ans: 1

Sol. From Snell's law $\mu = \frac{\sin i}{\sin r} \Rightarrow \sin r = \frac{\sin i}{\mu}$

As i is constant $\sin r \propto \frac{1}{\mu}$

1) air to water = $\frac{\mu_\omega}{\mu_a} = \frac{4}{3} = \mu_1$

2) water to glass = $\frac{\mu_g}{\mu_\omega} = \frac{3/2}{4/3} = \frac{9}{8} = \mu_2$

3) glass of water = $\frac{\mu_\omega}{\mu_g} = \frac{4/3}{3/2} = \frac{8}{9} = \mu_3$

As $\mu_1 > \mu_2 > \mu_3$ $\therefore$ $\sin r_1 < \sin r_2 < \sin r_3$

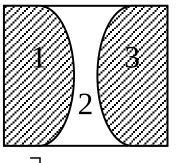
$\therefore$ Increasing order is a, b, c

37. The effective focal length of the lens combination shown in figure is –60 cm. The radii of curvature of the curved surfaces of the plano-convex lenses are 12 cm each and refractive index of the material of the lens is 1.5. The refractive index of the liquid is **[EAMCET 2006 M]**

1) 1.33 2) 1.42 3) 1.53 4) 1.60

Ans; 4

Sol. The given figure is



When lens are kept in contact

$$\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2} + \frac{1}{f_3} \ldots\ldots\ldots\ldots\ldots(1)$$

from lens makers formula

$$\frac{1}{f_1} = (\mu - 1)\left[\frac{1}{R_1} - \frac{1}{R_2}\right] \Rightarrow \frac{1}{f_1} = (1.5 - 1)\left[\frac{1}{\infty} - \frac{1}{-12}\right]$$

$$\frac{1}{f_1} = \frac{1}{24} \ldots\ldots\ldots\ldots..(2)$$

$$\frac{1}{f_2} = (\mu - 1)\left(\frac{1}{-12} - \frac{1}{12}\right) = -\frac{(\mu - 1)}{6} \ldots\ldots\ldots\ldots(3)$$

$$\frac{1}{f_3} = (1.5 - 1)\left(\frac{1}{12} - \frac{1}{\infty}\right) = \frac{1}{24} \ldots\ldots\ldots\ldots\ldots\ldots\ldots(4)$$

Also F = - 60 cm ……….(5)

$\therefore$ from (1), (2), (3), (4), (5)

$$-\frac{1}{60} = \frac{1}{24} - \frac{(\mu - 1)}{6} + \frac{1}{24}$$

On solving μ = 1.6

38. A combination of two thin lenses of the same material with focal lengths $f_1$and f_2, arranged on a common axis minimizes chromatic aberration, if the distance between them is **[EAMCET 2005 M]**

1) $\frac{(f_1+f_2)}{4}$ 2) $\frac{(f_1+f_2)}{2}$ 3) (f_1+f_2) 4) $2(f_1+f_2)$

Ans: 2

Sol. The condition for minimizing chromatic observation is the distance between them is $\left(\frac{f_1+f_2}{2}\right)$

39. If the focal length of a double convex lens for red light is f_R, its focal length for the violet light is **[EAMCET 2005 M]**

1) f_R 2) greater than f_R 3) less than f_R 4) $2f_R$

Ans: 3

Sol. From lens makers formula

$$\frac{1}{F}=(\mu-1)\left[\frac{1}{R_1}-\frac{1}{R_2}\right]$$

As $\mu_V>\mu_R$ $\therefore$ $F_R > F_V$ since $\frac{1}{F}<(\mu-1)$

$\therefore$ Focal length for the violet light is less than for red light

40. A thin equiconvex lens is made of glass of refractive index 1.5 and its focal length is 0.2m. If it acts as a concave lens of 0.5 m focal length when dipped in a liquid, the refractive index of liquid is **[EAMCET 2005 M]**

1) $\frac{17}{8}$ 2) $\frac{15}{8}$ 3) $\frac{13}{8}$ 4) $\frac{9}{8}$

Ans: 2

Sol. $\frac{1}{F_{air}}=(\mu_g-1)\left[\frac{1}{R_1}+\frac{1}{R_2}\right]$..............(1)

$\frac{1}{F_{liq}}=\left(\frac{\mu_g}{\mu_\ell}-1\right)\left[\frac{1}{R_1}+\frac{1}{R_2}\right]$............(2)

dividing (1) and (2)

$$\frac{F_{liq}}{F_{air}}=\frac{(\mu_g-1)\mu_\ell}{(\mu_g-\mu_\ell)}$$

$$\frac{0.5}{0.2}=\frac{-(1.5-1)\mu_\ell}{(1.5-\mu_\ell)}$$

on solving $\mu_\ell=\frac{7.5}{4}=\frac{15}{8}$

41. A thin converging lens is made up of glass of refractive index 1.5. It acts like a concave lens of focal length 50 cm., when immersed in a liquid of refractive index 5/8. The focal length of the converging lens in air is, in metres **[EAMCET 2004 M]**

1) 0.15 2) 0.20 3) 0.25 4) 0.40

Ans: 2

Sol. From lens makers formula

$$\frac{1}{F_{air}} = \left(\mu_g - 1\right)\left[\frac{1}{R_1} + \frac{1}{R_2}\right] \text{........(1)}$$

$$\frac{1}{F_{liquid}} = \left(\frac{\mu_g - \mu_\ell}{\mu_\ell}\right)\left[\frac{1}{R_1} + \frac{1}{R_2}\right] \text{........(2)}$$

glass and liquid dividing (1) and (2)

$$-\frac{F_{liq}}{F_{air}} = \frac{\left(\mu_g - 1\right)\mu_\ell}{\left(\mu_g - \mu_\ell\right)}$$

[- ve sign because of concave nature]

$$-\frac{50}{F_{air}} = \frac{(1.5-1)15/8}{(1.5-15/8)}$$

on solving F_{air} = 0.2 m

42. The phenomenon used in optical fibres for transmission of light energy is **[EAMCET 2004 M]**

1) Total internal reflection
2) Scattering
3) Diffraction
4) Refraction

Ans: 1

Sol. Total internal reflection so that no loss of energy takes place during transmission of light energy.

43. In Foucault's rotating mirror experiment to determine the velocity of light in air, the distance of the rotating mirror from the concave mirror is 6000 metres. The reflected ray is displaced through an angle of $48\pi \times 10^{-3}$ radians. If the velocity of light in air is $3 \times 10^{-8}\,m/s$, the number of rotations made by the rotating mirror in one minute are **[EAMCET 2003 M]**

1) 3,000
2) 9,000
3) 18,000
4)36,000

Ans: 3

Sol. Velocity of light in air = $\frac{4\pi nd}{\theta}$

n = number of rotations = $= \frac{c\theta}{4\pi d}$

Given $c = 3 \times 10^8 ms^{-1}, \theta = 48\pi \times 10^{-3}$rad

d = distance of rotating mirror from = 6000 m
concave mirror

on substituting in above equation

n = 300 turns / s = 1800 turns/ min

44. One of the refracting surface of a prism of the refractive index $\sqrt{2}$ is silvered. The angle of the prism is equal to the critical angle of a medium of refractive index 2. A ray of light incident on the unsilvered surface passes through the prism and retraces its path after reflection at the silvered face. Then the angle of incidence on the unsilvered surface is **[EAMCET 2003 M]**

1) 0°
2) 30°
3) 45°
4) 60°

Ans: 3

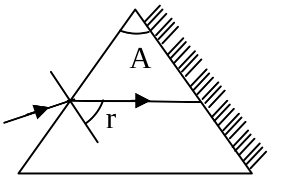
Sol. Given that A = C

$\therefore\ \mu = \frac{1}{\sin c} \Rightarrow \sin c = \frac{1}{\mu} = \frac{1}{2}$

$\therefore$ C = A = 30°

$\therefore$ angle of refraction = 30°

$\mu = \frac{\sin i}{\sin r} \Rightarrow \sin i = \sqrt{2} \times \frac{1}{2} = \frac{1}{\sqrt{2}} \Rightarrow i = 45°$



45. A ray of light is incident at 60° on prism of refracting angle 30°. The emerging ray is at an angle 30° with the incident ray. The value of refractive index of the prism is **[EAMCET 2002 M]**

1) $\frac{\sqrt{3}}{4}$ 2) $\frac{\sqrt{3}}{2}$ 3) $\sqrt{3}$ 4) $2\sqrt{3}$

Ans: 3

Sol. Angle of prism = 30° = A

Angle of incidence = i_1 = 60°

Angle of emergence = i_2 = ?

Angle of deviation = D = 30°

$\therefore$ i_2 = A + D – i_2 = 30 + 30 – 60 = 0°

$\Rightarrow r_2 = 0°$ $\therefore$ r_1 = A-r_2 = 30 – 0 = 30°

$\therefore\ \mu = \frac{\sin i_i}{\sin r_1} = \frac{\sin 60°}{\sin 30°} = \sqrt{3}$

46. The focal length of biconvex lens of refractive index 3/2 is 40 cm. Its focal length in meters, when immersed in a liquid of refractive index 4/3 is **[EAMCET 2002 M]**

1) 160 2) 16 3) 1.6 4) 0.5

Ans: 3

Sol. $\frac{1}{F_{air}} = (\mu_g - 1)\left[\frac{1}{R_1} + \frac{1}{R_2}\right]$.........(1)

$\frac{1}{F_{liq}} = \left(\frac{\mu_g - \mu_\ell}{\mu_\ell}\right)\left[\frac{1}{R_1} + \frac{1}{R_2}\right]$................(2)

dividing (1) and (2)

$$\frac{F_{liq}}{F_{air}} = \frac{(\mu_g - 1)\mu_\ell}{(\mu_g - \mu_\ell)} = \frac{\left(\frac{3}{2} - 1\right)\left(\frac{4}{3}\right)}{\left(\frac{3}{2} - \frac{4}{3}\right)} = 4$$

$\therefore\ f_{liq} = 4f_{air} = 4(40) = 1.6m$

47. A converging crown glass lens has a focal length 20 cm for the violet rays. Its focal lengths for red rays is (given $\mu_r = 1.53, \mu_v = 1.56$) **[EAMCET 2001 M]**

1) 20.82 cm 2) 21.13 cm 3) 22.85 cm 4) 24.85cm

Ans: 1

$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} + \frac{1}{R_2}\right) \Rightarrow f \alpha \frac{1}{\mu - 1}$

$\therefore\ \frac{f_{red}}{f_{violet}} \frac{\mu_v - 1}{\mu_R - 1} = \frac{1.54 - 1}{1.52 - 1}$

$$\Rightarrow f_{Red} = \left[\frac{0.54}{0.52}\right]20 = 20.76\text{cm}$$

48. Consider the following two statements A and B, and identify the correct choice in the given answer. **[EAMCET 2001 M]**
A : In Huygens eyepiece, the two plane surfaces of two planoconvex lenses face towards the eye.
B: In Huygens eyepiece the focal length of the field lens is equal to the focal lengthy of eye lens.
1) Both A and B are true 2) A is true but B is false
3) A is false but B is true 4) Both A and B are false
Ans: 2

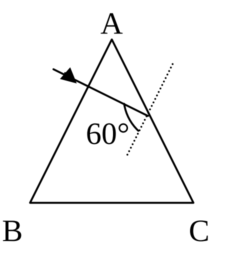
Sol. In Huygen's eyepiece, the two plane surface of two plano convex lenses face towards the eye. But the focal length of the field lens is thrice to the focal length of eye lens

49. Fraunhofer lines are due to **[EAMCET 2001 M]**
1) the diffraction effects in the atmosphere
2) the absorption of Sun's radiation by the earth's atmosphere
3) the absorption of Sun's radiation by the Sun's atmosphere
4) the characteristic emission of Sun's radiation
Ans: 3

Sol. Dark lines observed in the solar spectrum due to absorption of suns radiation by the suns atmosphere.

50. When a ray of light is incident normally on one refracting surface of an equilateral prism [Refractive index of the material of the prism is 1.5] **[EAMCET 2000 M]**
1) Emerging ray is deviated by 30°
2) Emerging ray is deviated by 45°
3) Emerging ray just grazes the second refracting surface
4) The ray undergoes total internal reflection at the second refracting surface
Ans: 4

Sol: Angle of the prism = 60°
Refractive index = 1.5
Angle of incidence at the 1st face AB =0°
Angle of incidence at the 2nd face AC is 60° which is greater than the critical angle of glass (42°).
Therefore total internal reflection takes place.



51. In Focault's rotating mirror experiment for determining the velocity of light. The distance between the rotating mirror and convex lens is negligible. When compared to the radius of curvature of the concave mirror. If the radius of curvature of the concave mirror is doubled, the image shift is **[EAMCET 2001 M]**
1) halved 2) doubled 3) zero
4) independent of radius of curvature of concave mirror
Ans: 2

Sol: Velocity of light $C = \frac{8\pi nad^2}{(b+d)x}$

As b < d, 'b' can be neglected

$\therefore\ x = \frac{8\pi nad^2}{(d)(c)} \Rightarrow x \propto d$

As 'd' is doubled, image shift also will be doubled.

52. Consider the following two statements A and B and identify the correct choice in the given answer: **[EAMCET 2000 M]**

A : The curved surfaces of Plano convex lenses in Ramsden's eye piece face each other.

B: The focal length of the field lens is three times the focal length of eye lens in Ramsden's piece

1) Both A and B are true
2) Both A and B are false
3) A is true and B is false
4) A is false and B is true

Ans: 3

Sol: In Ramsden's eye-piece, focal lengths of field lens and eye-lens are equal.

53. In a compound microscope the focal lengths of two lenses are 1.5 cm and 6.5 cm. If an object is placed at 2 cm from objective and the final image is formed at 25 cm from eye lens, the distance between the two lenses is **[EAMCET 2000 M]**

1) 6.00 cm
2) 7.75 cm
3) 9.25 cm
4) 11.00 cm

Ans:4

Sol: f_0 = 1.5 m = focal length of objective

f_e= 6.25 cm = focal length of eye piece

$u_0 = 2cm$ and $v_e = D = 25cm$

$\therefore$ image distance from the objective $V_0 = \frac{u_0 f_0}{u_0 - f_0} = 6cm$

Object distance from the eye-piece $u_e = \frac{v_e f_e}{v_e - f_e} = 5cm$

$\therefore$Length of the microscope = $v_0 + u_e = 6 + 5 = 11cm$

❖ ❖ ❖