Q.1 A light ray traveling parallel to the principal axis of a concave mirror strikes the mirror at angle of incidence θ. If radius of curvature of the mirror is R, then after reflection, the ray meets the principal axis at distance d from the centre of curvature, then d is -

(A) $\frac{R}{2}$ (B) $\frac{R\cos\theta}{2}$

(C) $\frac{R}{2\cos\theta}$ (D) $\frac{R}{2}(1+\cos\theta)$

[C]

Q.2 The image of an object placed on the principal axis of a concave mirror of focal length 12 cm is formed at a point which is 10 cm more distant from the mirror than the object. The magnification of the image is

(A) 8/ 3 (B) 2.5 (C) 2 (D) 1.5

[D]

Q.3 The focal length of a concave mirror is f and the distance from the object to the principal focus is x. The ratio of the size of the image to the size of the object is -

(A) $\frac{f+x}{f}$ (B) $\frac{f}{x}$ (C) $\sqrt{\frac{f}{x}}$ (D) $\frac{f^2}{x^2}$

Sol. **[B]**

$\frac{I}{O}=\frac{f}{f-u}$ here $f = u + x$ so $\frac{I}{O}=\frac{f}{x}$

Q.4 Find the angle of incidence for which angle of deviation from a liquid drop is minimum in a primary rainbow.

(A) 30º (B) 40º

(C) 50º (D) 60º **[D]**

Sol.

$\sin i = \mu \sin r$ … (1)

differentiating eq. (1) $\cos i\, di = \mu \cos r\, dr$

or $\frac{dr}{di}=\frac{\cos i}{\mu\cos r}=\frac{1}{2}$

or $2\cos i = \mu \cos r$

or $4\cos^2 i = \mu^2\cos^2 r = \mu^2(1-\sin^2 r)$

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

or $3\cos^2 i = \mu^2 - 1$

or $\cos i = \sqrt{\frac{\mu^2-1}{3}} = \sqrt{\frac{\left(\frac{4}{3}\right)^2-1}{3}} = \sqrt{\frac{7}{27}}$

or $\cos i = \sqrt{.26} = .5$

or $i = 60^o$

Q.5 A concave mirror is used to focus the image of a flower on a nearby well 120 cm from the flower. If a lateral magnification of 16 is desired, the distance of the flower from the mirror should be -

(A) 8cm (B) 12cm

(C) 80cm (D) 120cm

Sol. **[A]**

$\frac{v}{u} = 16$ $\quad v = u + 120$

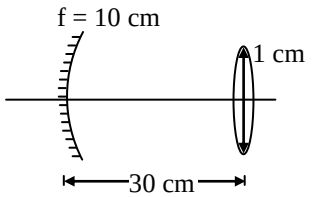
$\therefore \frac{120+u}{u} = 16 \Rightarrow u = 8\text{cm}$

Q.6 A particle moves in a circle of diameter 1 cm with a constant angular velocity. A concave mirror of focal length 10 cm is placed with its principal axis passing through the centre of the circle and perpendicular to its plane. The distance between the pole of the mirror and the centre of the circle is 30 cm. The ratio of acceleration of image to that of object is -

(A) $\frac{1}{2}$ (B) $\frac{1}{4}$

(C) 2 (D) 4 **[A]**

Sol.



$|m| = \left|\frac{f}{f-u}\right| = \left|\frac{-10}{-10+30}\right| = \frac{1}{2}$

$$\frac{r_I}{r_o} = m = \frac{1}{2}$$

$$\omega_o = \omega_I$$

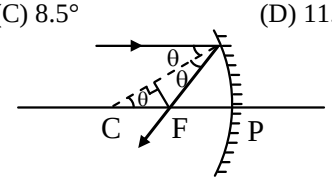
$$\therefore \frac{a_I}{a_o} = \frac{r_I}{r_o} = \frac{1}{2}$$

Q.7 Parallel rays striking a spherical mirror far from the optic axis are focussed at a different point than are rays near the axis thereby the focus moves toward the mirror as the parallel rays move toward the outer edge of the mirror. What value of incidence angle θ produces a 2 % change in the location of the focus, compared to the location for θ very close to zero ?

(A) 3.5° (B) 5.5°

(C) 8.5° (D) 11.5° **[D]**

Sol.



$$f = PF = R - \frac{R}{2}\sec\theta$$

for $\theta = 0$, $f = \frac{R}{2}$

$$0.98\, f = R - \frac{R}{2}\sec\theta$$

$$\Rightarrow 0.98\, f = \frac{R}{2}(2 - \sec\theta)$$

$$\Rightarrow 0.98 = 2 - \sec\theta$$

$$\Rightarrow \sec\theta = 1.02$$

$$\Rightarrow \cos\theta \simeq 0.98$$

$$\Rightarrow 1 - \frac{\theta^2}{2} = 0.98$$

$$\Rightarrow \theta = 0.2 \text{ radian} =$$

$$\frac{0.2\times 180}{\pi} \simeq 11.5°$$

Q.8 A concave mirror of focal length 15 cm forms an image having twice the linear dimensions of the object. The position of the object when the image is virtual will be-

(A) 22.5 cm (B) 7.5 cm

(C) 30 cm (D) 45 cm **[B]**

Sol. $f = -15$cm

for virtual & 2 times large image

$m = +2$

$$m = \frac{f}{f-u} \quad \text{or} \quad +2 = \frac{-15}{-15-u}$$

$$-30 - 2u = -15$$

$$-2u = 15$$

$$u = -7.5 \text{ cm}$$

Q.9 What will be the height of the image when an object of 2 mm is placed at a distance 20 cm infront of the axis of a convex mirror of radius of curvature 40 cm ?

(A) 20 mm (B) 10 mm

(C) 6 mm (D) 1 mm **[D]**

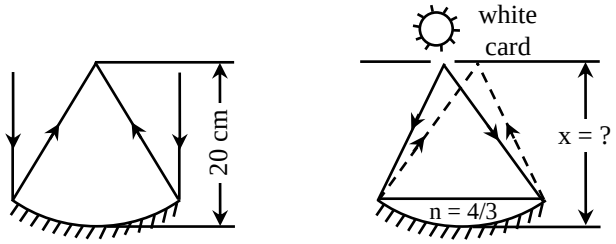
Sol. $f = R/2$

$\therefore$ $f = +20$ cm, $u = -20$ cm, $h_0 = 2$ mm

$$m = \frac{h_i}{h_0} = \frac{f}{f-u} \quad \therefore \quad \frac{h_i}{2} = \frac{20}{20-(-20)}$$

$h_i = 1$ mm

Q.10 A curved mirror brings collimated light to focus at x = 20 cm. as shown in figure (1). Then it is filled with water $n = \frac{4}{3}$ (as shown in Fig. (2)) and illuminated through a pinhole in a white card. A sharp image will be formed on the card at what distance, X?



(1) (2)

Fig.

(A) 10 cm (B) 20 cm

(C) 30 cm (D) 40 cm

Sol.(C) From (a), we find that the focal length of the mirror is $f_a = 20$ cm (in air).

Suppose the focal length is f_b when the mirror is filled with water. When paraxial rays are refracted at a plane surface, the object distance y and the image distance y' are related by

$$y' = \frac{n'y}{n},$$

Q.11 A man standing in front of a concave spherical mirror of radius of curvature 120 cm sees an erect image of his face four times its natural

size. Then the distance of the man from the mirror is -

(A) 180 cm (B) 300 cm

(C) 240 cm (D) 45 cm **[D]**

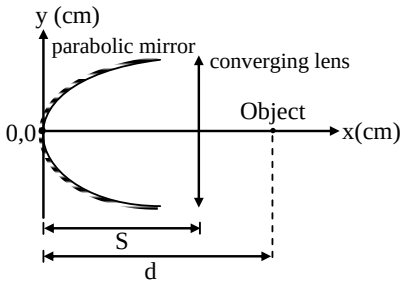
Sol. $m = \frac{f}{f-u}$, $m = +4$

$f = \frac{-120}{2} = -60\text{cm}$

$\therefore \quad +4 = \frac{-60}{-60-u} \quad \therefore \quad -60 = -240 - 4u$

$\therefore \quad 4u = -180 \quad \therefore \quad u = -45$ cm

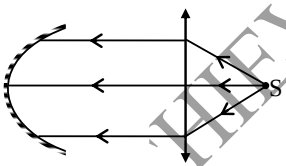
Q.12 Focal length of converging lens is 20 cm, S = 80 cm and d = 100 cm. Find the position co-ordinate of final image after one refraction and reflection at mirror –



(A) 3.16 cm, 0 (B) 8.23 cm, 0

(C) 10.53 cm, 0 (D) 1.16 cm, 0 **[A]**

Sol,



In parabolic mirror, parallel incident ray converge at focus

$y^2 = \frac{x}{8}$

Here $t = \frac{1}{32}$ m

Image will formed at $\frac{1}{32}$ m or 3.16 cm

Q.13 An object is placed at 20cm from a convex mirror of focal length 10cm. The image formed by the mirror is -

(A) Real and at 20cm from the mirror

(B) Virtual and at 20cm from the mirror

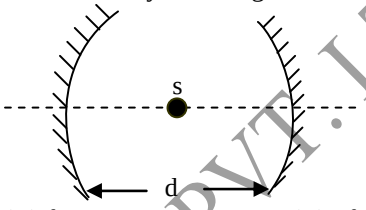
(C) Virtual and at 20/3cm from the mirror

(D) Real and at 20/3 cm from the mirror

Sol. **[C]**

$\frac{1}{10} = \frac{1}{v} - \frac{1}{20} \Rightarrow v = \frac{20}{3}$ virtual image

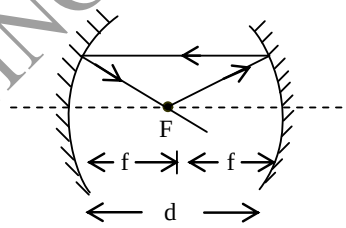
Q.14 Two concave mirror each of focal length f. A point source is placed at a point midway between two mirror. The minimum value of d for which only one image of s is formed –



(A) f (B) 2f

(C) 3f (D) 4f **[B]**

Sol.



It is only possible if object and image coincide.

Q.15 A virtual image three times the size of the object is obtained with a concave mirror of radius of curvature 36cm. The distance of the object from the mirror is

(A) 5 cm (B) 12 cm

(C) 10 cm (D) 20 cm

Sol. **[B]**

$m = +3$ (virtual)

$f = -\frac{R}{2} = -18$ cm

$m = -\left(\frac{f}{u-f}\right)$

$mu - mf = -f$

$u = \left(\frac{m-1}{m}\right) f$

$= \left(\frac{3-1}{3}\right) \times -18$

$= -\frac{2}{3} \times 18$

$= -12$ cm

Q.16 An object is kept between a plane mirror and a concave mirror facing each other. The distance between the mirrors is 22.5 cm. The radius of curvature of the concave mirror is 20 cm.What should be the distance of the object from the concave mirror so that after two successive reflections the final image is formed on the object itself: [Consider first reflection from concave mirror]

(A) 5 cm (B) 15 cm
(C) 10 cm (D) none of these **[B]**

Q.17 A particle is moving towards a fixed spherical mirror. The image.

(A) must move away from the mirror
(B) must move towards the mirror
(C) may move towards the mirror
(D) will move towards the mirror, only if the mirror is convex **[C]**

Q.18 A point object on the principal axis at a distance 15 cm in front of a concave mirror of radius of curvature 20 cm has velocity 2mm/s perpendicular to the principal axis. The velocity of image at that instant will be:

(A) 2 mm/s (B) 4 mm/s
(C) 8 mm/s (D) none of these **[B]**

Q.19 A point object at 15 cm from a concave mirror of radius of curvature 20 cm is made to oscillate along the principal axis with amplitude 2mm. The amplitude of its image will be:

(A) 2 mm (B) 4 mm
(C) 8 mm (D) none of these **[C]**

Q.20 A luminous point object is moving along the principal axis of a concave mirror of focal length 12 cm towards it. When its distance from the mirror is 20 cm its velocity is 4 cm/s. The velocity of the image in cm/s at that instant is :

(A) 6 , towards the mirror
(B) 6, away from the mirror
(C) 9, away from the mirror
(D) 9, towards the mirror **[C]**

Q.21 In case of concave mirror, the minimum distance between a real object and its real image is -

(A) f (B) 2f
(C) 4f (D) Zero **[D]**

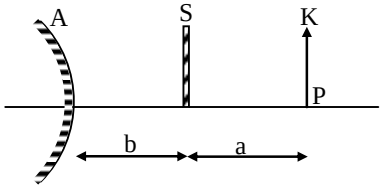
Q.22 A concave mirror of focal length 15cm forms an image having twice the linear dimensions of the object. The position of the object when the image is virtual will be -

(A) 22.5cm (B) 7.5cm (C) 30cm (D) 45cm

Sol. **[B]**

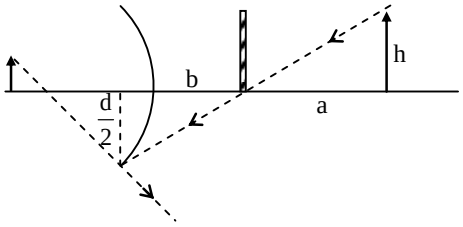
$$-\frac{1}{15}=-\frac{1}{2u}+\frac{1}{u}\Rightarrow u=-7.5m$$

Q.23 A screen S is placed at a distance b = 5 cm from a circular convex mirror as shown in figure. An object KP of height h = 3 cm is arranged at a distance a = 5 cm from the screen. What are the maximum dimensions of the object (with the given arrangement of the object, the mirror and screen) for the mirror to reproduce an image of the entire object diameter of mirror in d = 10 cm.



(A) 5 cm (B) 15 cm
(C) 25 cm (D) 20 cm **[A]**

Sol.



$$\frac{h}{a}=\frac{d}{2b}$$

$$h=\frac{ad}{2b}=\frac{5\times10}{2\times5}=5\ cm$$

Q.24 The focal length of spherical mirror is -
(A) Maximum for red light
(B) Maximum for blue light
(C) Maximum for white light
(D) Same for all lights **[D]**

Q.25 In image formation from spherical mirrors, only paraxial rays are considered because they-
(A) are easy to handle geometrically
(B) contain most of the intensity of the incident light
(C) form nearly a point image of a point source
(D) show minimum dispersion effect **[C]**

Q.26 A short linear object is placed along optic axis of a concave mirror. If distance of nearer end of the object from the mirror is greater than radius of curvature then -
(A) a real and elongated image will be formed
(B) a virtual and elongated image will be formed
(C) a real and diminished image will be formed
(D) a virtual and diminished image will be formed **[C]**

Q.27 A concave mirror is used to form an image of the sun on a white screen. If the lower half on the mirror were covered with an opaque card, the effect on the image on the screen would be -
(A) to make the image less bright than before
(B) to make the lower half of the image disappear
(C) to prevent image from being focused
(D) none of the above **[A]**

Q.28 The image formed by a concave mirror -
(A) is always real
(B) is always virtual
(C) is certainly real if the object is virtual
(D) is certainly virtual if the object is real
[C]

Q.29 A short linear object is placed along optic axis of a concave mirror. If the object is in between pole and focus, then -
(A) a virtual image will be formed
(B) a real diminished image will be formed
(C) If object is in between pole and focus then a real and elongated image will be formed
(D) None of these **[A]**

Q.30 A real inverted and equal in size image is formed by -
(A) A concave mirror
(B) A convex mirror
(C) Plane mirror
(D) None of the above **[A]**

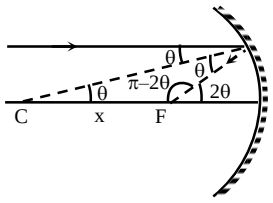
Q.31 A ray of light traveling parallel to the principal axis of a concave mirror strikes the mirror at an angle of incidence θ. If radius of curvature of the mirror is R, then after reflection, the ray meets the principal axis at a distance x from the centre of curvature. Then x is -

(A) $\frac{R}{2}$ (B) $\frac{R}{2\tan\theta}$

(C) $\frac{R}{2\cos\theta}$ (D) $\frac{R}{2\sin\theta}$ **[C]**

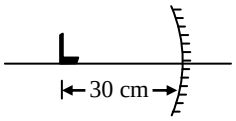
Sol. $\frac{x}{\sin\theta} = \frac{R}{\sin(\pi-2\theta)}$ so $x = \frac{R}{2\cos\theta}$

$\frac{x}{\sin\theta} = \frac{R}{\sin 2\theta}$



Q.32 Check the only wrong statement out of the following -
(A) A convex mirror can give a virtual image
(B) A concave mirror can give a virtual image
(C) A concave mirror can give a diminished virtual image
(D) A concave mirror can give a real image **[C]**

Q.33 A small wire piece of length 2 mm is bent in the form of shape L and is placed at 30 cm away in front of a concave mirror of focal length 20 cm. If both sides of L are equal then length of image formed will be -



(A) 2 mm (B) 4 mm
(C) 6 mm (D) 8 mm **[C]**

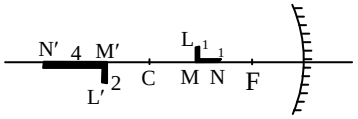
Sol. Transverse magnification

$$m = \frac{f}{f-u} = \frac{-20}{-20+30} = -2$$

Longitudinal/Axial magnification

$m' = -m^2 = -4$

$\therefore$ Length of image = $(1 \times 2) + (1 \times 4) = 6$ mm



Q.34 Which one of the following can produce a parallel beam of light from a point source of light ?
(A) Concave mirror (B) Convex mirror
(C) Plane mirror (D) Concave lens **[A]**

Q.35 Looking into a mirror one finds his image long and thin, the mirror is -
(A) Concave (B) Convex
(C) Cylindrical (D) Parabolic **[C]**

Q.36 A convex mirror is used to form an image of a real object. Then tick the wrong statement-
(A) the image lies between the pole and focus
(B) the image is diminished in size
(C) the image is erect
(D) the image is real **[D]**

Q.37 The focal length of a concave mirror is f and the distance of the object from the focus is u (away from the mirror). The magnification produced by the mirror is -
(A) f / u (B) uf
(C) u / f (D) f^2 / u **[A]**

Q.38 An object is placed 18 cms away from a concave mirror whose focal length is 10 cms. Then the size of area of the image if the object be 4 mm broad and 12 mm long is – (Assume plane of object is perpendicular to axis of mirror)
(A) 1.5 cm^2 (B) 0.5 cm^2
(C) 0.75 cm^2 (D) 2 cm^2 **[C]**

Q.39 A small piece of wire bent into an L shape with upright and horizontal portions of equal lengths, is placed with the horizontal portion along the axis of the concave mirror whose radius of curvature is 10 cms. If the bend is 20 cms from the pole of the mirror, then the ratio of the lengths of the images of the upright and horizontal portions of the wire is -
(A) 1 : 2 (B) 3 : 1
(C) 1 : 3 (D) 2 : 1 **[B]**

Q.40 A motor car is fitted with a convex driving mirror of focal length 20 cm. A second motor car 2 m broad and 1.6 m high is 6 m away from the first car. Then the position of the second car as seen in the mirror of the first car is -
(A) 19.4 cm (B) 17.4 cm
(C) 21.4 cm (D) 15.4 cm **[A]**

Q.41 An inverted image of a real object can be seen in a convex mirror -
(A) Under no circumstances
(B) When object is very far from the mirror
(C) When the object is at a distance equal to the radius of the mirror
(D) When the object is at a distance equal to the focal length of the mirror **[A]**

Q.42 In case of a curved mirror if the distance of object (u) and image (v) are measured from the pole and a graph is plotted between (1/u) and (1/v). The graph is a -
(A) Straight line passing through the origin
(B) Straight line making an intercept with both $\frac{1}{u}$ and $\frac{1}{v}$ axes
(C) Parabola
(D) Hyperbola **[B]**

Q.43 In case of a curved mirror if the object and image distances are measured from the focus and a graph is plotted between them. The graph will be -

(A) Straight line passing through the origin

(B) Straight line not passing through the origin

(C) Parabola

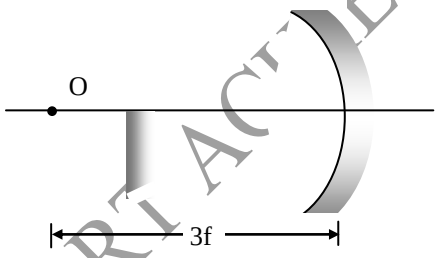
(D) Hyperbola **[D]**

Q.44 A short linear object of length b lies along the axis of a concave mirror of focal length f at a distance u from the pole of the mirror. The size of the image is approximately equal to -

(A) $b\left(\frac{u-f}{f}\right)^{1/2}$ (B) $b\left(\frac{f}{u-f}\right)^{1/2}$

(C) $b\left(\frac{u-f}{f}\right)$ (D) $b\left(\frac{f}{u-f}\right)^{2}$ **[D]**

Q.45 An object O is placed in front of a plane mirror and concave mirror as shown in fig. If 'f' is the focal length of concave mirror then the separation between the two mirrors so that image obtained after two reflections coincides with object O is:



(A) $\frac{9f}{4}$ (B) $\frac{7f}{4}$

(C) f (D) None of these

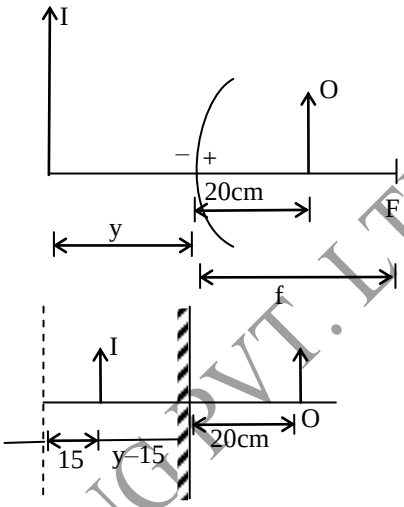
[A]

Q.46 An object is 20 cm away from a concave mirror and it is within the focal length of the mirror. If the mirror is changed to a plane mirror, the image moves 15 cm closer to the mirror.
Focal length of the concave mirror is -

(A) 36.6 cm (B) 56.6 cm

(C) 66.6 cm (D) 46.6 cm

Sol. **[D]**



$\frac{1}{f} = \frac{1}{20} - \frac{1}{y}$

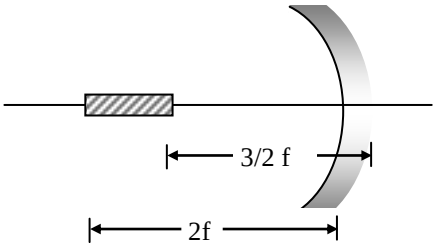
$\frac{1}{y} = \frac{1}{20} - \frac{1}{f}$; $y = \frac{20f}{f-20}$

$y - 20 = 15$ (given)

$\frac{20f}{f-20} = 35$

$f = \frac{700}{15}$ cm

Q.47 A linear object is placed along the axis of a mirror as shown in fig. If 'f' is the focal length of the mirror then the length of image is -



(A) $\frac{2f}{3}$ (B) f

(C) $\frac{f}{3}$ (D) None of these

[B]

Q.48 For a mirror linear magnification m come out to be +2. What conclusions can be drawn from this -

(A) mirror is concave

(B) mirror can be convex or concave but it can not be plane

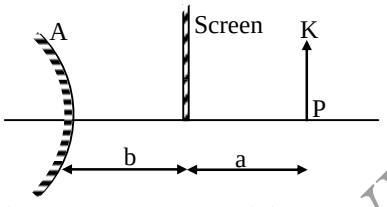
(C) object lies between pole and focus

(D) object lies beyond focus

Sol. **[A,C]**

m = + 2 means image is virtual, erect & magnified. Virtual magnified image can be formed only by a concave mirror & that too when object lies between pole & focus

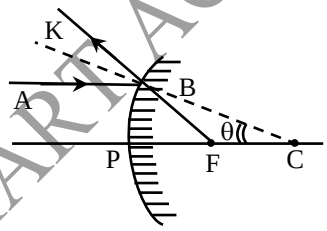
Q.49 A screen S is placed at a distance b = 5 cm from a circular convex mirror as shown in figure. An object KP of height h = 3 cm is arranged at a distance a = 5 cm from the screen. What are the maximum dimensions of the object (with the given arrangement of the object, the mirror and screen) for the mirror to reproduce an image of the entire object. Diameter of mirror is d = 10 cm.



(A) 5 cm (B) 15 cm

(C) 25 cm (D) 20 cm **[A]**

Q.50 In the adjoining figure, AB represents the incident ray and BK the reflected ray. If angle BCF = θ, then ∠ BFP is given by :



(A) θ (B) 2θ

(C) 3θ (D) 2.5θ **[B]**

Sol. **[B]**

∠BFP = θ + ∠CBF = θ + r = θ + θ = 2θ