1. (b) If end *A* of rod acts an object for mirror then it's image will be *A*' and if

*C*

*A'*

*F*

*A*

2*f*

*f* / 3

*v*

*u* = 2*f* – (*f*/3)

 so by using 

 

 Length of image 

1. (b) From the following ray diagram it is clear that



*α*

*α­ –β*

*δ*

*β*

*A*

*O*

*B*

*­α – β*

*r*

*r*

*β*

*α­*

*α*

*i*

*r*

*n*

1. (a) From the following figure

*r* + *i* = 900 ⇒ *i* = 900 – *r*

For ray not to emerge from curved surface *i* > *C*

⇒ sin *i* > sin *C* ⇒ sin (90o – *r*) > sin *C* ⇒ cos *r* > sin *C*

⇒  

⇒ ⇒ 

⇒  ⇒  {sin *i* → 1}

⇒ Least value 

1. (b) **Case (i)** When flat face is in contact with paper.

0.04 *m*

 where

= *R*. *I*. of medium in which light rays are going = 1

= *R*. *I*. of medium from which light rays are coming = 1.6

*u* = distance of object from curved surface = – 0.04 *m*

*R* = – 0.04 *m*.



*i.e.* the image will be formed at the same position of cross.

**Case (ii)** When curved face is in contact with paper

0.04 *m*

****

 (Below the flat face)

1. (c) Let *x* be the apparent position of the silvered surface.

Object

Image

*x*

8 *cm*

12 *cm*

12 +(6–*x*)

*t* = 6 *cm*

According to property of plane mirror

*x* + 8 = 12 + 6 – *x* *x* = 5 *cm*

Also

1. (b) For *glass-water* interface  …(i)

For *water-air* interface  …(ii)

 

 

1. (a) For TIR at *AC*

*B*

*A*

*θ*

*C*

*θ*









1. (d) 

⇒

*F*

+

+

*f*1

*f*2

*f*3

 …(i)

 …(ii)

 …(iii)

 

1. (d)  where  and  are the refractive indices of the material of the lens and of the surroundings respectively. For a double concave lens,

 is always negative.

*n*1

*n*1

*n*2

Hence  is negative only when 

1. (b) Convex lens will form image  at it’s focus which acts like a virtual object for concave lens.

30 *cm*

4 *cm*

26 *cm*

*I*1

*I*2

Hence for concave lens ,  So by lens formula  *i.e.* distance of final image  from concave lens  by using 

1. (d) For achromatic combination





 

Resultant 

 =

1. (a) 

On putting 

1. (d) Here 

Plano-convex lens silvered on plane side has .

 

Plano-convex lens silvered on convex side has 



Now using , we get 

1. (a) From the geometry of the figure

*P*1

*P*2

*P*3

*a*

*a*

60°

30°



so, 



and 

=



All options are wrong.

1. (c) Distance of object from mirror

= 15+= 39.93 *cm*

Distance of image from mirror =15 + =33.75

For mirror, 

⇒ ⇒ *f* ≈ –18.3 *cm.*

1. (c) = 4 *cm/sec.*
2. (c) 

*θ*

*d*

*x*



= 6.1 *mm*

*i.e.* order will be 5 *mm*.

1. (c) = 5*m*
2. (c) Let distance between lenses be . As per the given condition, combination behaves as a plane glass plate, having focal length .

So by using 

 

1. (c) From figure it is clear that relative velocity between object and it's image = 2*v* cos*θ*

*O*

*I*

*v cos θ*

*v*

*v*

*θ*

*θ*

*v cos θ*

1. (b) Image formation by a mirror (either plane or spherical) does not depend on the medium.

The image of *P* will be formed at a distance *h* below the mirror. If *d* = depth of liquid in the tank.

Apparent depth of 

Apparent depth of the image of 

∴ Apparent distance between *P* and it's image 

1. (a) From the figure it is clear that the angle between incident ray and the emergent ray is 90o.

Incident ray

45o

Emergent ray

45o

⇒

45o

45o

*r*

*r*

1. (b) From figure it is clear that object appears to be raised by 

5 *cm*

10 *cm*

*O*

*cm*

*O*'

Hence distance between mirror and 

So final image will be formed at 12.5 *cm* behind the plane mirror.

1. (d) Velocity of approach of man towards the bicycle = (*u – v*)

Hence velocity of approach of image towards man is 2(*u – v*).

1. (c) For *A*

Total number of waves =  ....(i)

 

For *B* and *C*

Total number of waves =  ....(ii)

Equating (i) and (ii) 

1. (b) Since there is no parallex, it means that both images (By plane mirror and convex mirror) coinciding each other.

*A*

Object

50 *cm*

30 *cm*

20 *cm*

10 *cm*

According to property of plane mirror it will form image at a distance of 30 *cm* behind it. Hence for convex mirror *u* = – 50 *cm, v* = + 10 *cm*

By using  

  

1. (d) For surface *P,* ⇒ 

For surface *Q*, ⇒ 

∴ 

Magnification of 

∴ Height of 

Magnification of 

∴ Height of 

1. (b) Focal length of mirror 

*P*

*Q*

10*m*

*R*

*C*

20 *m*

For part *PQ* : transverse magnification

length of image *L*1 = 

= 

For part *QR* : longitudinal magnification

Length of image 

=  ⇒ 

1. (d) The two slabs will shift the image a distance

****

Therefore, final image will be 1 *cm* above point *P*.

1. (a) Here optical distance between fish and the bird is



Differentiating *w.r.t t* we get 

⇒  ⇒ 

1. (b) In case of refraction from a curved surface, we have

⇒⇒*v* =– 30 *cm.*

*μ* = 1

*P*

*O*

*C* '

*C*

*A*

*D*

*B*

15 *cm*

20 *cm*

*μ*=4/3

*I*

*μ*=2

10 *cm*

*i.e*. the curved surface will form virtual image *I* at distance of 30 *cm* from *P*. Since the image is virtual there will be no refraction at the plane surface *CD* (as the rays are not actually passing through the boundary), the distance of final image *I* from *P* will remain 30 *cm*.

1. (d) As  the upper half of the lens will become diverging.

As  the lower half of the lens will become converging

1. (b)

10*cm*

(*f*–10)*cm*

*f*

Imaging object

*O*

From the figure,

Using property of plane mirror

Image distance = Object distance

*f –* 10 = 10 

1. (d) If initially the objective (focal length *Fo*) forms the image at distance *vo* then 

Now as in case of lenses in contact  

So if one of the lens is removed, the focal length of the remaining lens system

 ⇒ 

This lens will form the image of same object at a distance  such that 

So to refocus the image, eye-piece must be moved by the same distance through which the image formed by the objective has shifted *i.e.* 15 – 6 = 9 *cm*.

1. (b) By using 

= 327.5

1. (d)

*r*1

*α*

*n*1

*A*

*i*

*B*

*P*

*R*

*S*

*T*

*n*2

*n*3

*β*

*r*2

*r*3

*γ*

*Q*

*E*

*F*

90°

*α =* 90 *– r*1

*β =* 90 *– r*2

*γ =* 90 *– r*3

*C*

*D*

At *B*

 ⇒  .... (i)

At *C*

⇒....(ii)

At *D*

⇒ ....(iii)

At *E*

⇒ ....(iv)

Adding (i), (ii), (iii) and (iv) we get 