Experimental Physics - II
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Lecture - 18
Applications of Mirrors and Lenses

We have demonstrated how to measure the focal length of lens, mirrors. Now in this class, I would like to discuss what is the use of this lens and mirror in our day to day life. All of you are familiar with the application of this lens and mirror, but still let me tell you once more what the applications of the convex lens, concave lens, concave mirror, convex mirror are; application of mirror and Application of Mirrors and Lenses.

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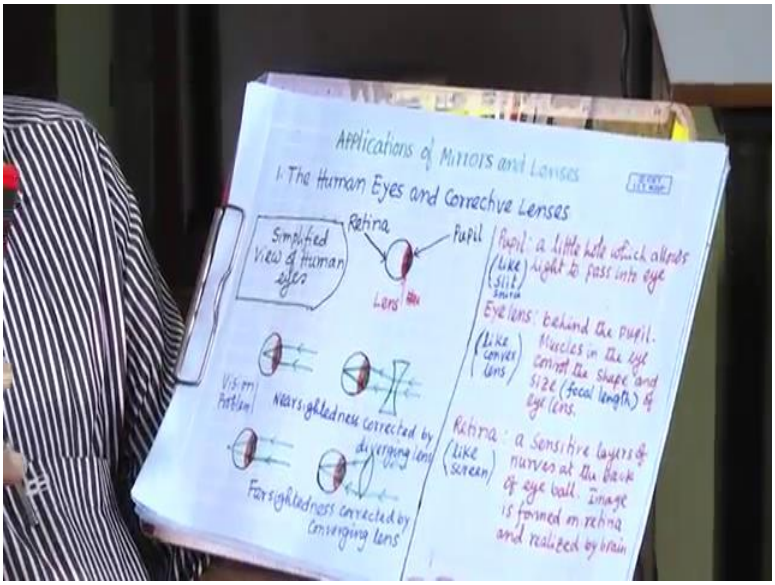

first application you can see I have spectacle, for human the first application very useful application for our spectacle. the human eyes and the corrective lenses, so you know the simplified this is the simplified view of human eye. In human eye, so this black we see this black part in the eye, so that is called pupil. And then behind this pupil there is a lens, there is a lens, and back side of this lens it is called retina,

thus pupil is it is a if we compare with our experiment whatever is demonstrated, so pupil is is the slit, is the in terms of the light in the eye, so that is the pupil and then from slit light comes and falls on the lens, falls on the lens, Slit or yes, it control the entrance of the light in the eye. this is the lens, difference of human lens, eye lens and the lens

we are using, so one of the lens we are using that is the fixed, that is the hard lens and it is the you cannot change its shape and size, so its focal length is fixed. But human lens this muscle, eye muscle it can change its shape and size, so that means, it can change its, adjust its focal length,

light will come and it will converge, this is the convex lens kind of things. it is a light will converge and fall on the retina. retina is, so retina is screen you know, on screen we get see we get the image on retina it is a like a screen if you compare with our experiment, so image will fall on the screen.

this retina, behind the retina it is a nerves are there, it is connected with the brain and then brain realize this image of the object from where this light is coming and passing through the pupil, this is the human eye and you can see this is the exactly same, it is the that eye is forming the image of the object and that same, same way as we have demonstrated in our lab. we have object, we have lens and we have screen, we catch the screen, catch the image on the screen,

now, defective eye; we use spectacle eye. Defective eye means, if it happens that this rays are coming from the object and passing through the pupil and this light converge through the lens eye lens and this image is not falling on the retina, it is the it is the, but they converge before that retina. it is called near sightedness, it is called near sightedness,

if this is the case then we cannot see the image, ok, we cannot see the image properly, it is the focused one on the screen, we can see only when it will be focused on the retina. if we use a lens it is a diverging lens. these rays are coming here, so they are converging before the retina. if you can diverge, if you can diverge this ray slightly then it will converge the far distance from this vision distance, so it will be on retina, accordingly one has to choose the focal length of this diverging lens, so this, we use the divergent lens to correct this vision,

from the ray diagram you can see now it is falling on the image is falling on the retina. Similarly, other way also it may happen that this it focused this image is formed beyond the retina, ok, at this point. it is called far sightedness. in this case, if you use the convex lens in spectacle, if you use the convex lens then here ray are coming, so it will diverge

in some extent here and then rest of the divergence by this eye lens and it will fall on the retina, from ray diagram you can see it along the retina.

this is the it is corrected by the converging rays, this is very important application of the lens, convex lens and concave lens for human eyes for medical science,

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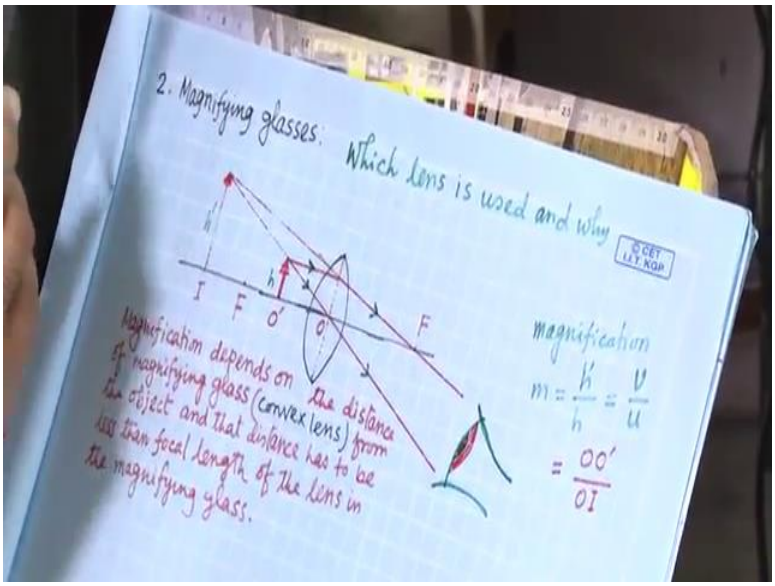

second application I can tell you this all of us most of us we are using is the magnifying glass. this is the magnifying glass, so. you see the yeah small letter, to see the small letter in bigger form, so we use magnifying glass. in this glass what is there? Whether it is a lens if lens. which lens? Is that concave lens or convex lens?

it is convex lens is used. And why it is used? and also always we have seen that we when we use this magnifying glass, so magnifying glass always we, always it is quite close to the object, it is quite close. we are not seeing like this, it is not near the eye it is near the object, ok, it is near the object, ok, it is near the object.

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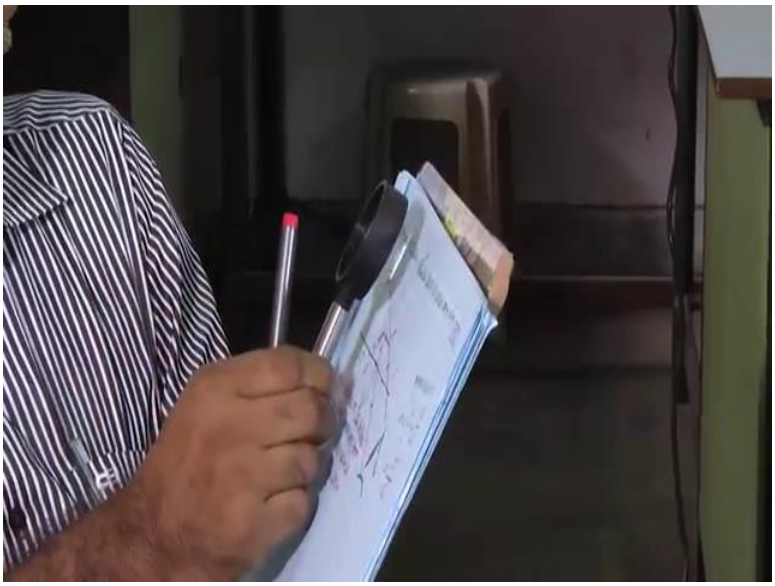

you know this convex lens when the object is within the object distance is less than the focal length of the lens, then we will see that erect and magnified, erect and magnified image, from ray diagram you can see, so that is the object, Now, this is the lens. parallel rays one is falling how to draw the ray diagram you know, there are ray now it will pass through the focal length, focal point and another ray passing through the optical ray. this is the ray. It is a diverging.

Now, our eye will see that rays are coming from this place, eye will see that ray is coming from this point. image, eye will see the image here, of that object an image size is this, so it is a magnified, this is the magnifying glass, this is the magnifying glass we are using as convex lens and we use the magnifying glass close to the, close to the object reason is that we have to keep the object within the focal length, .

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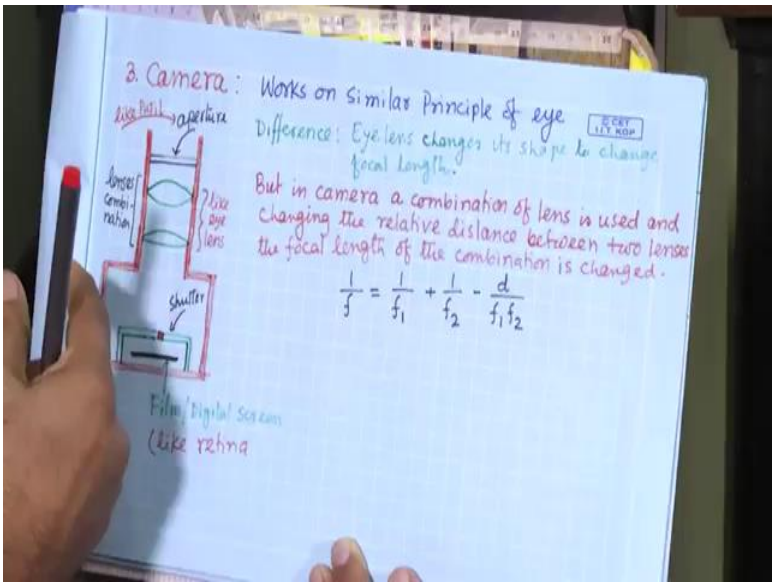

third application I can tell you that this is the camera, camera. this you know this somebody is recording my lecture, ok, so they are using camera. they are focusing this page, this focusing is using the lens, in camera what is there? Camera is a it is called aperture it is a like pupil aperture. it controls, it controls in terms of the light in the camera, so there is a combination of lens there is a combination of lens here. For simplicity I have shown these two lens and they are separated by distance d,

Now, this is the film or digital screen where this image will form and there is a shorter, you can you can control the entrance of the light on the film, when you will open the shutter, so light will fall. this is the typical simplified structure of the camera, your object is outside, no, so light is coming from the object from outside, it will enter. Now, this you're this position if fixed, your screen is fixed, your film is fixed,

Now, object distance or is the higher distance, ok, so you want to you want to get image, you want to put the image on the on the screen; that means, you want to focus the image on the screen, definitely it will defame on the focal length of this lens, now, using one lens you cannot change the focal length, You need different focal length for focusing object of at different distance on a fixed screen, , on a see that fixed distance. that is why you have to you have to change the focal length of this of the lens, you need combination of lens that is what it is used.

this focal length of this combination is 1 by f 1 plus 1 by f 2, they are again fixed for two lens. Now, here a new hand this d is there, so there is option here you are when you are focusing you are rotating; that means, you are moving one of the lens, you are moving one of the lens related to the other one, so you are changing the d. as a result you are changing the focal lens. in this way you are getting variable focal length, to focus the object outside object, at different distance to put the image on the on the screen placed at a fixed steps compared to the say fixed lengths one can say,

this is another example of use of the, huge use of the lens, whatever the experiment we have done? What is the principle we have learnt? these are the things we use for making this device, and they in our daily life we are using, you are using them. from our knowledge we can understand how this device works,

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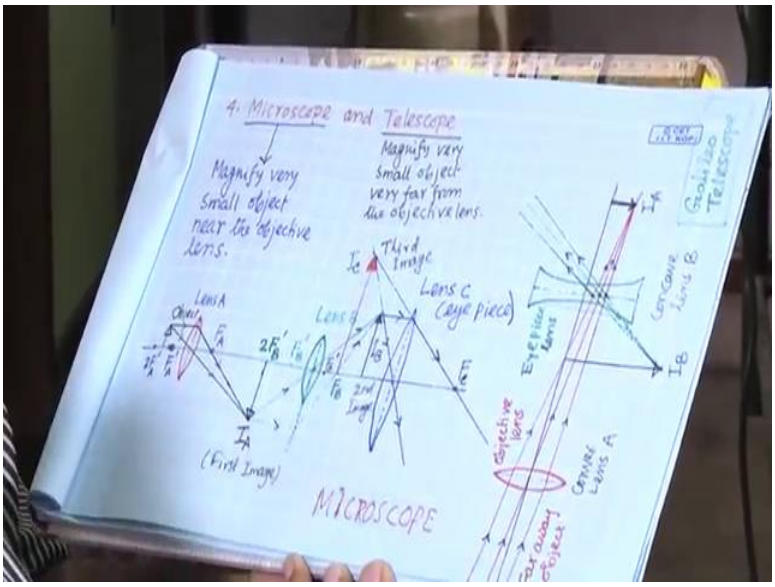

next application I can tell you in our scientific lab, in a in biochemistry lab, in the hospital, in fishing lab, in science lab, scientific lab in astrophysics, ok, in biologic if you see the biological cell, ok, so these two is device microscope and telescope they are very useful. these two are complete completely based on the on the on the lens and mirrors, on the lens and mirrors.

microscope, why you why we use microscope? To see a small object, so to see the very small objects means this instrument can magnify the image of the object, how it works? What is there in this microscope? You see this if you take two lens if you take two lens,

here I have shown you this if you have three lens in micro these are compound microscope using one, so it is the combination of lens.

to magnify more and more and more, so you need combination of length. here is the diagram ray diagram I have shown. this is the object small object, I have put a lens here, so that is this object we have put between F and 2F of this lens, now if you draw the ray diagram, so image is formed here, you are getting inverted image, you are getting inverted image and real image, and magnified image, Now, these image for from the lens say, so I A,

So now, if you put another lens here the lens B, now this will be the object of this lens, so light is going from this object, the this image, image for this one, but it is a object for this lengths B, so it will form, it will form, so I should I should draw bigger one um. just I have extended it, this again ray diagram we can draw this is the passing through the optical center and another parallel passing through the focal length. they will meet here,

in this case, you are getting, you are getting the again compared to this one this is the inverted one, opposite it is downward so now upward and you are getting real image, But compared to their object, so now it is erect one, ok, it is erect one, it is in same direction, you have changed, so using another lens is not magnified with your same distance, so is it is put at the it happens when you will put a 2F B dash, means at the at the at the radius of the curvature of this lens if you put then you know you will get this, you can invert the image and image size will be same because u distance or v distance are same, so magnification is one, v by u,

here this lens is used just to invert this one, so that this one will be in the same direction of the object direction, Now, you are using third lens, and in such a way that this image which will be which will act like a object for this lens, ok, so it is in the focal length of this, within the focal length of this of this lens, then you will get the virtual image and you will get the virtual image for this lens C and erected image, this from ray diagram we can see it will fall at this place, and it will be magnified one. ultimately, combination of the these three lens is giving you a erect image, in same direction, same way you are getting as your object as well as you are getting very magnified one, that is the purpose, that is a purpose of this microscope or smaller object you can make it bigger and you can see it,

here you see just simple is based on the principle of the combination of the lens, Similarly, for telescope what is the purpose? To see the distance object, ok, to see the distant and small object. like star if you want to see, so use telescope, ray diagram I have given, so this is the, so from far away this I think I can I can show you like this, I can show you like this. from far away, so it is the Galileo telescope, the simple telescope, but here just two lenses are used, but modern telescope it has the lot of combination of lens, but principle is same,

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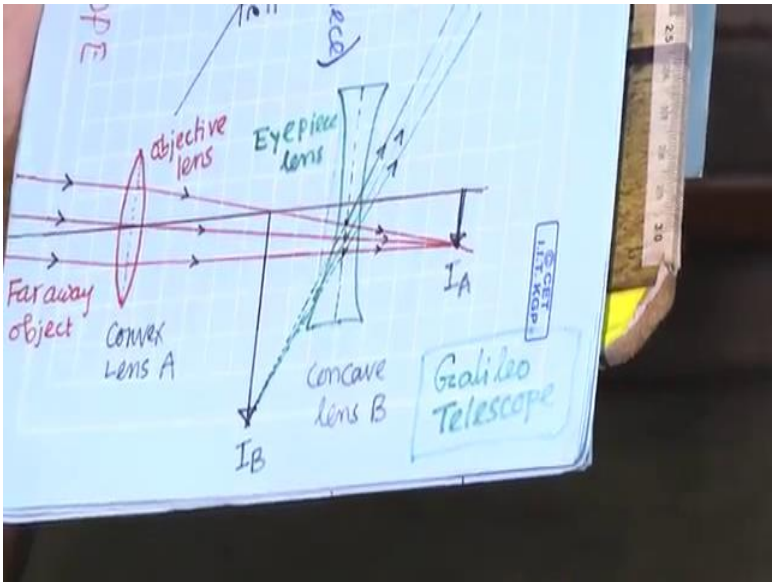

from far distance, so rays are coming, so parallel rays are coming, they are not parallel to the principle axis, but they are making some angle; if some make some angle. you will get the image you will get the image of this here; this is the image of the object that at long distance,

Now, it is a, so to make it to magnify it because it is a small object and it is the too long distance, so now, using these lens we have being that object in form of image is near to us. Now, if you use another lens it is the diverging lens here. what will happen? this rays are coming here, it will, so these are converging lens, this is a diverging lens. when this ray will pass through this diverging lens, so ray will not go this way it will diverge like this. all these three rays will diverge in this direction,

if you extend, so they will meet diverging. if you extend them, they will converge at this point, image will form here, image will form here, one can think that this is the object for

this lens, diverging lens and this diverging lens all the time it produces the erect and virtual image. with respect to this is the erect in same direction and virtual, because it is you have to extend, they are not directly meeting this refractive rays, so we have to extend them then only they are converging. with respect to this, this is the erect and virtual,

But with respect to this whatever image in this object it at a very large distance, so that object as the image you will see it is a as a large image as a large, in large form, And this lines is is a objective lens, this is called objective lens and this is the eye piece lens, combination of these two lens is making us to see the distant object in a bigger form, this is the telescope. again, if you see it is where we use to microscope and telescope, so they are based on the simple cognition of the lens and that is what in our lab we give importance of this experiment on this on this lens and mirrors which are which are very useful for our day to day life, .

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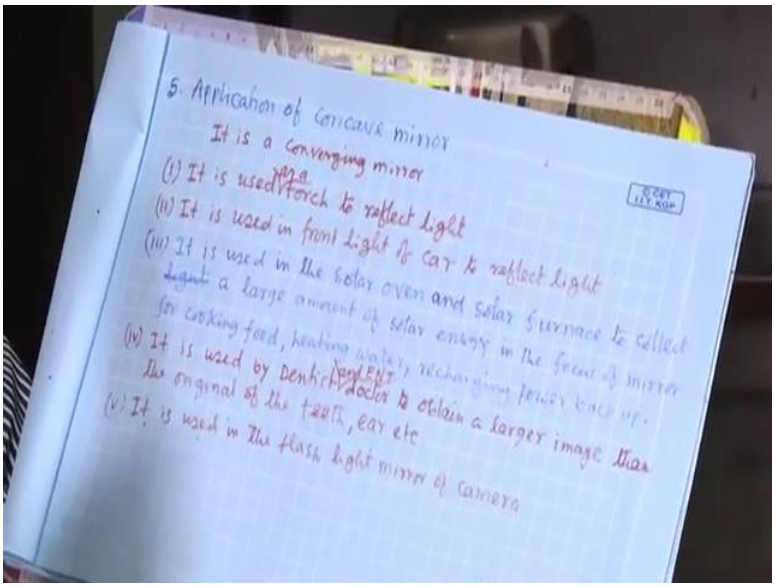

so far whatever I discussed that is for application of mirror. There are many applications, but few of them I have discussed which we are frequently used in our daily life. there is application of mirror also. application of mirror just briefly let me tell you, just mention you, that application of say concave mirror.

concave mirror is converging mirror, it is the equivalent to the equivalent to the convex lens, it is converging, these mirrors, concave mirror is used, it is used for converging the

rays. this mirror is useful where, so it is used as a torch to reflect light. If you see the torch light you have about outside of the torch you can see this there is a concave. I have one let me, yes, you can see here, you can see here.

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You have a bulb here, inside you have bulb, and surrounding this bulb we can see this the, it is the mirror, it is the concave mirror, concave mirror we are using concave mirror. this light on the bulb, it will go this all side, now this concave mirror inside it is there it will reflect this all this light and converge towards outside, you will get more light from the same bulb. in torch light, we use the concave mirror, ok, so that is what here one can see.

Second, second, in old car you will see this there is a bulb and they are also we use this; we use this concave mirror to reflect the light. it is used in front light of car, in car this front light, ok, there also if you see this, we use the concave mirror. same purpose as in torch I showed you, so to reflect the light, in front of the car to see the road, this concave mirror it is used in the solar oven, and solar furnace, to collect a large amount of solar energy in focus in the focus of the mirror for cooking food, heating water, recharging power, recharging power backup,

sunlight if you use the mirror then you can focus all light at a point, so you can you can concentrate this solar energy and that energy can, it can be used for burning the things, to generating the heat; you can cook, you can cook food, you can boil your water, etcetera,

etcetera. this is the third use of this concave mirror. Also, it is used by dentist or ENT doctor, to obtain a larger image then the original of the teeth.

now that they see the, so your teeth, so the they use this mirror concave mirror, ok, they can see the image of this teeth or this ear hole, inside what is there in the larger image, because if you if you place this concave mirror close to the object; that means, this that will be within the focal length of the concave mirror. you will get the virtual and erect image, just in plain mirror whatever the way we see, but plain mirror you cannot magnify, you can see the virtual image,

but here if you use concave mirror and if it if you place close to the object within the focal length of the concave mirror, then you can see the magnified image of your teeth or ear. doctor also very frequently they use this mirror. It is also used in the flashlight mirror of the camera, flashlight in camera we use. there this to reflect the light, ok, to focus the light, we use the concave mirror in the flashlight of the camera, then some points let me mention for the application of the convex mirror,

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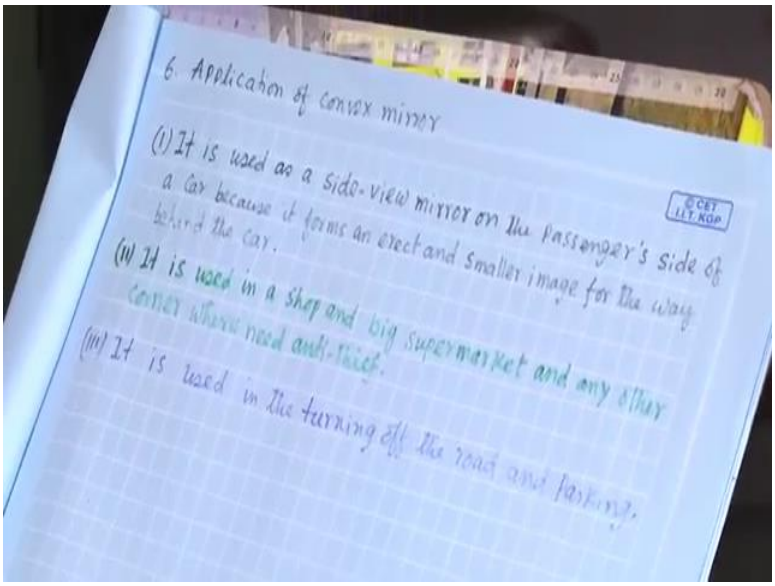

It is like a similar to the concave lens, All the time it forms the image, all the time it forms the image virtual image and erect image. it is used as a side view mirror of the passenger side of a car because it forms an erect and smaller image for the way behind the car. in car you know this; however, driver is sitting, seen both the driver this form seats, left side and side, so outside the side mirrors are there.

side mirrors are used to see the object backside of the car, there which mirror you will use, concave mirror or convex mirror? You cannot use concave mirror because concave mirror that image depends on the distance of the object, whether it will be virtual or you know whether it will be real image, so then it will be inverted, some case it is inverted, some case it; we cannot use that one.

you have to use, you have to use the convex mirror, you have to use the convex mirrors, you can, so all the time it will, it is independent of the distance of the object, all the time it will give you erect image, and smaller image than the actual image, actual object size, backside of the, backside of the car up to long distance behind the car you can see which car is coming, which who are coming, etcetera, etcetera. this is the, use of this convex mirror, in car all car has this mirror for side beam,

also it is used in a shop or big supermarket or any other corner where need anti-thief, if you go to the shop bigger shop you will see where that counter is there, cash counter is there, backside of the cash counter in corner there is a mirror and in that mirror you can you can see, you can see this whole shop what people are doing etcetera. that mirror is concave convex mirror,

there, so it can as I told that is objects are at different distance and, but the image is all the time it is virtual and smaller, and you will see the erect image, so that is how we tell this is the for anti-thief, it is the anti-thief mirror. to for security purpose, to check this what is happening in the shop whether someone is taking away the things from the shop or not. it is observed through this mirror, that mirror is convex mirror,

why it is convex mirror? I explained you. It is also you can see this mirror we use sometimes in the turning point, in the road in turning point; we see we put the mirror. that mirror also it is convex mirror. in turning point, so we are going this way, so seeing this mirror in mirror you will see the image this from other side who are coming, so other side you cannot see, but from this mirror you can see the in from the image, so who are coming.

that is why in road, ok, so for traffic purpose or in parking, ok, so this convex mirror is used, these are the I hear whatever application I mentioned for lens and mirrors, so this all of you have seen this application of the mirror. I try to explain this with the

knowledge whatever we have gained from the demonstration of the experiment in our lab,

just seeing the mirror you can immediately now you will be able to tell this is in car, in cars in side one whether it is convex or concave mirror or this in road in corner whatever mirror is put whether it is concave or convex, why it is concave or convex. this from this actually I tried to tell you that whatever application you are seeing now you will be able to explain properly how it works. That is the purpose of just briefing the application of this lens and mirror. I will stop here.

Thank you for your attention.