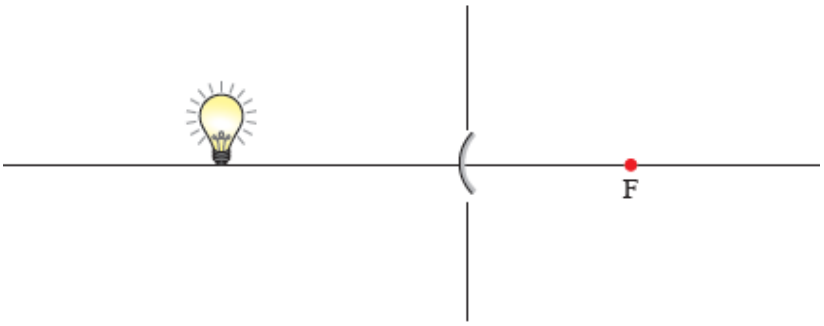
WAVES: REFLECTION QUESTIONS

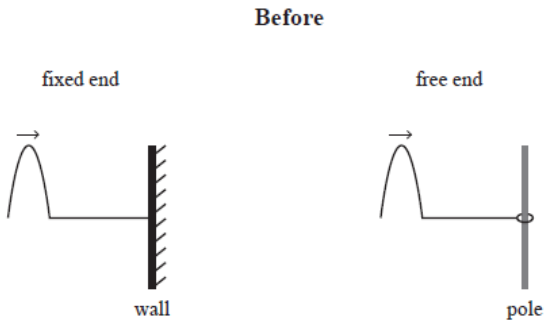
RAYS AND PULSES IN A ROPE (2022;3)

Helen continues to investigate light and optics. She chooses to look at the images formed by convex lenses, and then compares these with mirrors.

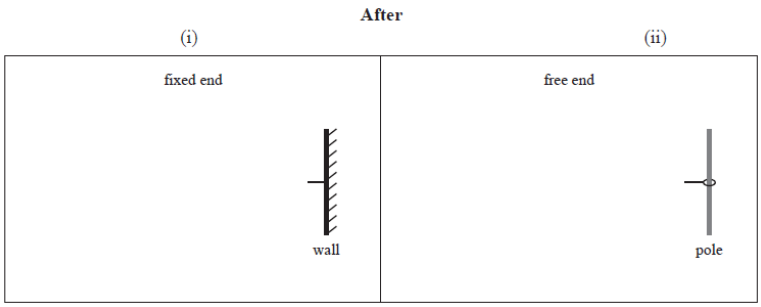
(b) Helen tries a lamp placed a distance of 3 cm in front of a convex mirror of focal length 2 cm.
(i) Complete the ray diagram.
(ii) Describe the image produced.



(c) To further investigate waves, Helen looks at the effect of sending a pulse down a rope, firstly with a fixed end, and then with a free end.



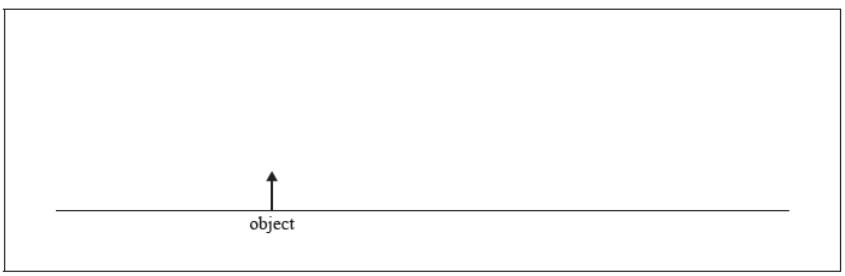
Complete the diagrams below to show the reflected pulses from each system.



(d) Helen wanted to see if she could create a virtual image with a concave mirror.

(i) Use a ray diagram to show how this is possible.

(ii) Describe the position of the object in relation to the mirror.



(iii) Compare the similarities and differences of the image (if any) with a virtual image formed by a convex mirror.

THE CAR (2021;3)

Fred notices the warning "Objects in mirrors are closer than they appear" printed on a **convex** side mirror of his car.

(a) Describe the type of image always formed by convex mirrors.

(b) Explain why concave mirrors would be no good as car mirrors to see distant objects.

(c) Complete the ray diagram below to locate the image formed by a convex mirror.

(d) A car 1.5 m high is 5.0 m behind Fred. When Fred looks in his convex minor of focal length 20 cm, he sees an image of the car. Calculate the distance AND height of the image that Fred sees in the mirror.

AT THE SWIMMING POOL (2020;1)

Mia and Aria are at the swimming pool. They notice the lifeguards are using a convex mirror on the wall to help them see the swimmers in the pool.

(a) Complete the ray diagram below to show the formation of the image.

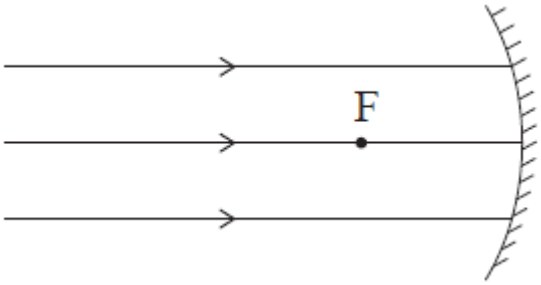
(b) Describe the nature, size, and orientation of the images of the swimmers formed by the mirror. Assume the mirror is far away from the swimmers.

(c) The lifeguards could have used a plane or concave mirror. By describing the possible images from each mirror, explain whether either mirror is suitable for the lifeguards to see the whole of the pool.

SATELLITE DISHES (2019;1)

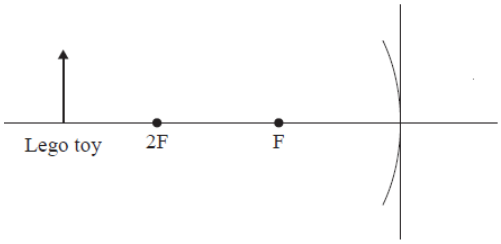
Satellite communications can help isolated communities stay in touch, as well as improve signals for television and radio communications. A typical receiver dish, shown below, can be used for a range of waves in the electromagnetic spectrum.
The receiver dish can be modelled using a concave mirror and light rays. Although a satellite dish is not truly concave, a teacher decides to model the image formation using a concave mirror.

(a) Complete the ray diagram to show how parallel rays are reflected in concave mirrors in general.



(b) The students realise that, in order to use the mirror for the model, they will need to know its focal length. They place a 3 cm high Lego toy 30 cm in front of the mirror and determine its image to be 2 cm high. By first determining the distance of the image from the mirror, calculate the focal length.

(c) (i) Draw two rays from the Lego toy (object) to locate the position of the image. Draw and label the image.



(ii) What would be the effect on the position of the image of increasing the radius of curvature of the mirror? Explain your answer.

THE ENLARGED EYE (2018;1)

Sophie and her friend John were investigating magnifying glasses (convex lenses). Sophie laughed at the size that John's eye appeared when he placed the lens over his eye.

(c) John cannot see the image of his own eye by looking through the lens. He decides to put the lens down and select one of three types of mirror – plane, convex or concave.

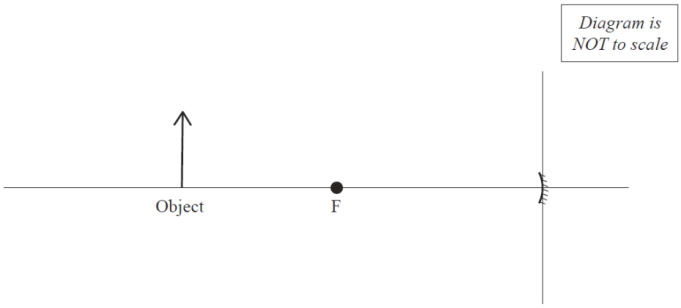
(i) Which type of mirror would give the best upright and magnified image of his eye? Justify your choice.

(ii) Where would John's eye need to be positioned to get an enlarged upright image for your choice of mirror?

(iii) Clearly explain where John's eye would need to be positioned to obtain the largest upright image possible for your choice of mirror.

Concave and convex mirrors (2017;1)

Sarah placed a candle in front of a concave mirror.



(a) Draw two rays from the candle (object) to locate the position of the image. Draw and label the image.

(b) The candle, which has a height of 20.0 cm, is placed 140.0 cm in front of the concave mirror. The mirror has a fixed focal length of 80.0 cm. Calculate the height of the image formed.

(c) Sarah then puts the same 20.0-cm-tall candle at the same 140.0 cm distance in front of a convex mirror, which also has a focal length of 80.0 cm. The images formed by the concave and convex mirrors are different.
Describe two differences in the images formed and explain why these differences occur. *No calculations are necessary.*

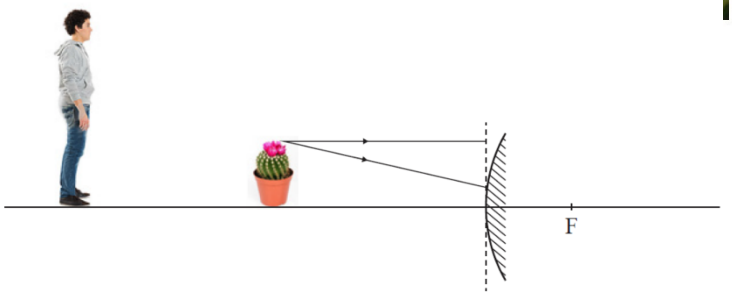
(d) The same 20.0-cm-tall candle is again placed in front of the first concave mirror of focal length 80.0 cm. The candle is moved until the image is upright and is three times the size of the object.

(i) Describe the nature of the image.
(ii) Calculate the distance the candle (object) is away from the mirror.

Light (2016;1)

Tim was looking into a convex mirror ball in his garden. Standing behind a small plant, he noticed that when he looked at the reflection of the plant in the convex mirror, it appeared smaller than it really was.

(a) Complete the simplified ray diagram (not to scale) to show where the image of the small plant would appear.



(c) The images produced by the convex mirror and the convex lens are quite different. The convex mirror produces a virtual image, and the convex lens produces a real image.

- Explain the difference between a real and a virtual image.
- Explain how Tim could detect the difference between the two images.

Mirrors (2015;1)

Sela is experimenting with curved mirrors.

(a) She places a lighted candle in front of a **concave mirror** and obtains an image on a screen. State the nature (real or virtual) and the orientation (upright or inverted) of the image.

(b) The image of the candle is formed 25.0 cm from the mirror. The focal length of the mirror is 16.0 cm. The height of the image is 0.50 cm. **Calculate** the **distance** of the object from the mirror and the **height** of the object.

(c) Sela then placed the candle in front of a **convex mirror**. Explain why she was unable to get an image of the candle on a screen.

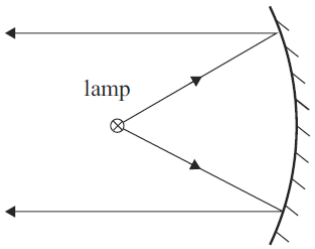
(d) Dentists use curved mirrors. Write a comprehensive explanation for why dentists use curved mirrors instead of plane mirrors to examine a tooth.

In your answer include:

- the name of the type of mirror they use
- a ray diagram.

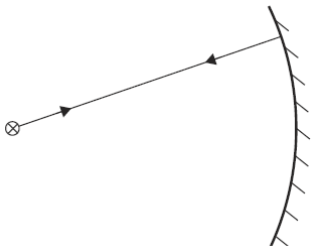
Moana's spotlight (2013;1)

Moana is trying to design a spotlight for her school production. She experiments with a lamp in front of a mirror, as shown in the diagram.



(a) State the name of the position where she has placed the lamp.

(b) She then places the lamp further from the mirror and notices that a light ray from the lamp reflects straight back to the lamp, as shown in the diagram.



i. State the name of the position of the lamp.
ii. Explain why the light ray reflects as shown.

Moana now moves the lamp closer to the mirror, as shown in the diagram. She sees a clear image of the lamp on the wall. The height of the image is twice the height of the lamp. The focal length of the mirror is 25 cm.

Calculate the distance from the mirror to the lamp.

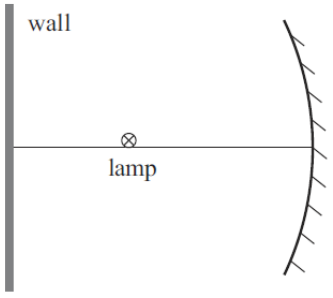
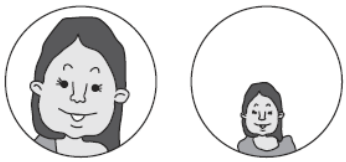


Diagram is NOT to scale

Moana attaches her mirror to the wall beside another, different mirror. When she looks at the mirrors, she sees two different images of herself as shown in the diagram.



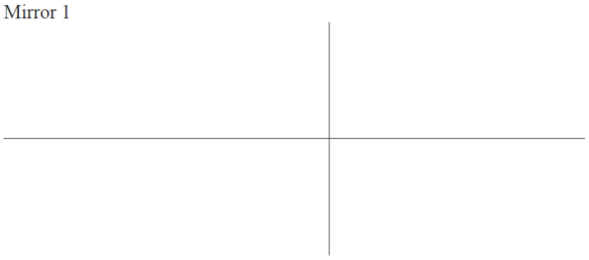
Mirror 1 Mirror 2

i What type of mirror is:

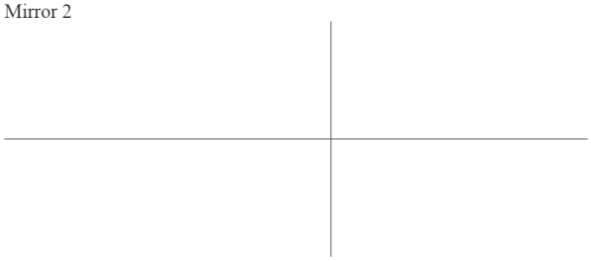
Mirror 1
Mirror 2

ii Draw ray diagrams to justify your answers to part (i). You will need to draw the appropriate mirror for each diagram.

Mirror 1



Mirror 2

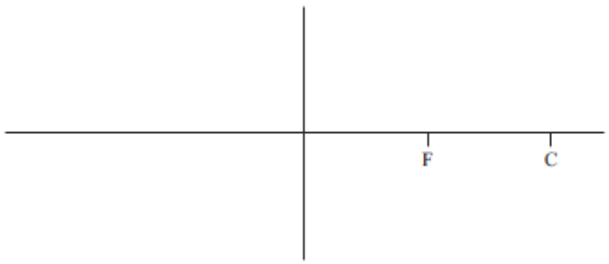


Curved mirrors and lenses (2012;1)

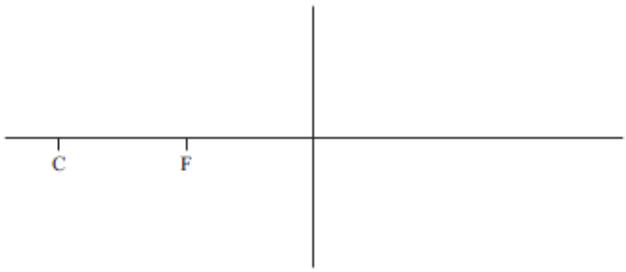
Sarah observed that it is possible to get a virtual image of an object using either a concave or a convex mirror.

(a) On each of the diagrams below, use a ruler to draw the path of two rays of light from an object (draw this as an arrow) to produce a **virtual image** for both a concave as well as a convex mirror. The vertical line represents the curved mirror.

(i) Concave mirror



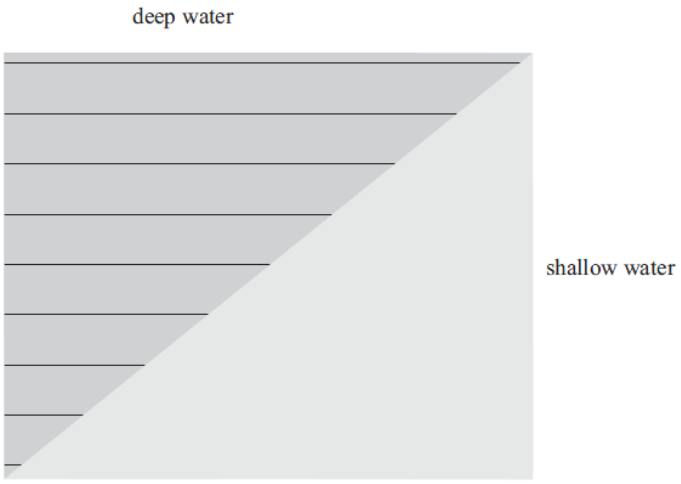
(ii) Convex mirror



(b) Describe two characteristics of virtual images in mirrors.

(c) Sarah places a candle at a distance of 4.5 cm in front of the **convex** mirror. She uses a candle that is 2.0 cm high as the object. The focal length of the **convex mirror** is 6.0 cm. Calculate the height of the image formed by the convex mirror.

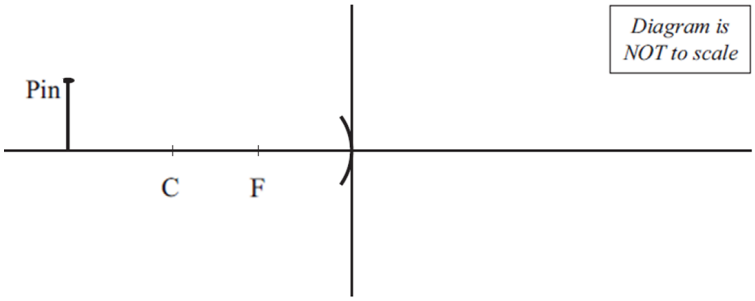
Refraction (2012;3)



(a) The diagram shows parallel wave fronts approaching shallow water. Waves travel slower in shallow water. Complete the diagram with **labelled** arrows showing the following:

- direction of travel **of the incident** wave fronts
- direction of travel of the **reflected** wave fronts

Curved mirrors and lenses (2010;2)



(b) Ashley places the pin in front of a concave mirror, as shown in the diagram. Draw appropriate rays on the diagram to locate the image of the pin.

(c) The height of the pin is 4.0 cm. The pin is placed at a distance of 12.5 cm from the mirror. The focal length of the mirror is 3.6 cm. Calculate the height of the image.

(d) Ashley then places the pin **between the focal point and the mirror**. Discuss the reason for the nature (real or virtual) and position of the image formed under these conditions.

Lenses (2009;1)

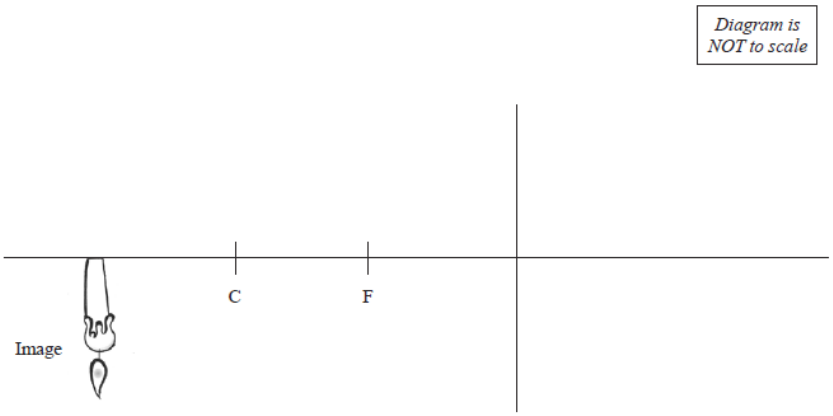
Bianca is driving to the boat harbour in her car. She looks in the rear-view mirror and notices that the image of a man standing behind her looks smaller than it does in a plane mirror. The focal length of her rear-view mirror is 40 cm.

(d) Name the type of mirror she is looking at.

(e) The man is 1.8 m tall, and he is 11 m away from the mirror. Calculate the height of his image (The focal length of the mirror is 40 cm).

Reflection (2008;3)

Jane puts a candle in front of a curved mirror and sees the image of the candle on a screen in front of the mirror. The image is inverted and larger than the candle itself. The diagram shows the image of the candle which Jane observes.



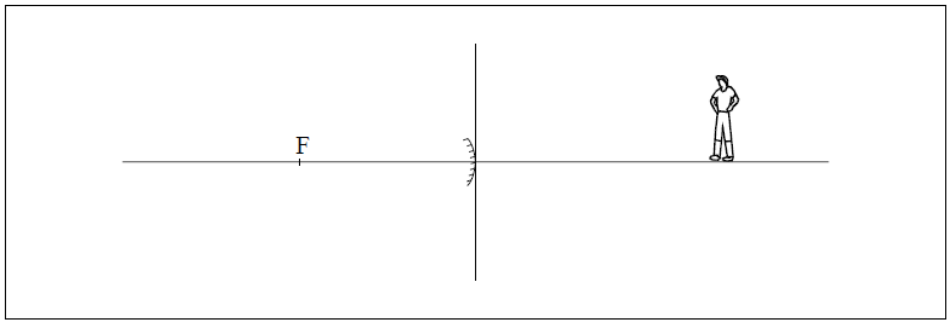
(a) Name the type of mirror that can produce this image.

(b) Complete the diagram by drawing suitable rays to show where the candle (object) was placed to get this image. Include arrows on your rays.

(c) The focal length of the mirror is 24.0 cm and the image is 60.0 cm from the front of the mirror. Calculate the distance the object must be placed in front of the mirror to produce this image.

Question one (2005;1)

Robbie and Amy are visiting the new aquatic centre in town. When Robbie is at the counter he looks at the security mirror on the wall. He notices that the mirror is curved, and it bends outwards in the middle.

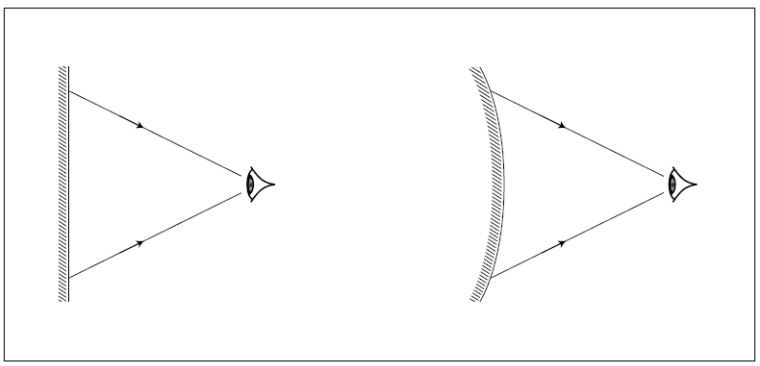


(a) On the diagram, draw appropriate rays to show how his image is formed.

(b) Calculate the magnification using your diagram.

(c) Robbie moves so he is standing 3.0 m away from the pole of the mirror. The mirror's radius of curvature is 2.0 m. Calculate the distance between Robbie and his image.

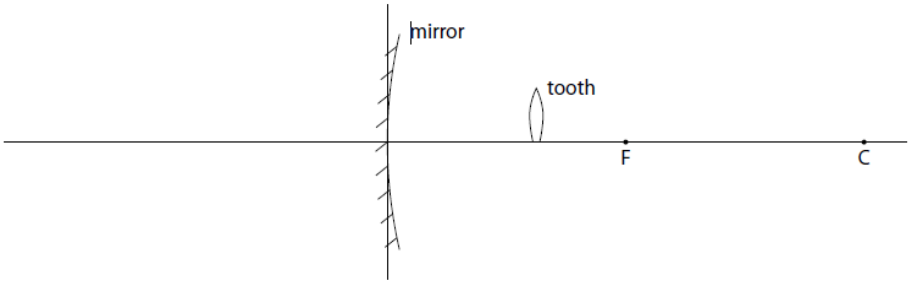
(d) The diagrams below represent rays of light reflected from near the ends of a plane mirror and the security mirror into Robbie's eye. Draw normals and incident rays and use them to explain the advantage of using a convex mirror.



Mirrors and lenses (2004;1)

Mere is a dentistry student. She is using a magnifying mirror to look at the tooth of her patient, Lee.

(a) Name the type of mirror that can produce a magnified image.
(b) Draw rays on the diagram below (not drawn to scale) to show how the image of Lee's tooth is formed in the mirror.



(c) Describe the nature of the image.
(d) Lee's tooth is 2.5 cm away from the mirror. The mirror has a focal length of 4.0 cm. Show by calculation that the distance between the mirror and the image of the tooth is 6.7 cm.
(e) Calculate the magnification of the tooth by the mirror.
(f) The image of the tooth is 2.0 cm high. Calculate the actual height of Lee's tooth.