

#1

What are the 7 different categories of the electromagnetic spectrum? List them from least to most energetic.

least energetic

radio waves
microwaves
infrared light
visible light
ultraviolet light
X-rays
gamma rays

most energetic
Name:

#3

Rank the following electromagnetic waves from least to most energetic: microwaves, x-rays, green light, red light, violet light, radio waves, ultraviolet light, gamma rays

least energetic

radio waves
microwaves
red light
green light
violet light
ultraviolet light
x-rays

gamma rays most energetic
Name:

#2

Gamma rays can cause cancer, but they can also be helpful. List at least 3 ways gamma rays are helpful to humans.

- ① - useful in astronomy to see distant galaxies
- ② - treats cancer (gamma knife)
- ③ - sterilization of food & surgical equipment

Name:

#4

In your opinion, which type of electromagnetic wave is most useful to humans? Explain in detail.

Opinions will vary.
e.g. visible light, because it allows us to see and perform our everyday tasks safely.

Name:

#5

How are is infrared light used by humans? List at least 3 ways.

- remote controls (e.g. TV, DVD)
- heat detection (policing & home efficiency)
- keeps food warm
- astronomy
- physical therapy

Name:

#7

List the 7 distinct colors that Isaac Newton identified in the visible spectrum from least to most energetic.

least energetic

Red
Orange
Yellow
Green
Blue
Indigo
Violet

most energetic

Name:

#6

Ultraviolet rays can cause cancer, but they can also be helpful. List at least 2 ways UV rays are helpful to humans.

- produce vitamin D
- sterilizes food by killing bacteria
- astronomy
- entertainment (school dances)

Name:

#8

What is the advantage to placing telescopes in space as opposed to on Earth's surface?

Allows more of the EM spectrum to be used, as most of the microwaves, infrared light, UV light, x-rays & gamma rays are blocked by Earth's atmosphere - provides more information from additional types of radiation

Name:

#9

Incandescence is the production of light from heat. Two examples of incandescence are:

- incandescent light bulb
- hot metals (in a forge)
- burning candle / fire

Name:

#11

How do objects "glow in the dark"?

phosphorescent materials absorb high energy UV light and emit this light at a lower energy level (visible light) over a period of time after the UV light was absorbed.

Name:

#10

Electric discharge creates light when electric current passes through a gas. Two examples of light from electric discharge are:

- lightning
- neon signs
- Geissler tubes (gas tubes)

Name:

#12

What is the main difference between light from phosphorescence and light from fluorescence?

Phosphorescence emits the lower energy visible light over extended periods of time, whereas fluorescent materials emit this visible light immediately.

Name:

#3

Explain how a glow stick creates light. What type of light production is this?

Two chemicals are separated by a glass tube in the glow stick. When the glow stick is bent, the glass cracks allowing the two chemicals to react. This reaction produces light but almost no heat.

Name:

#5

Give 5 examples of organisms that produce light through bioluminescence. Why would these organisms create light?

Angler fish, fire-flies, glow-worms, certain bacteria, fungi, jellyfish, squid, etc.

Light may be created for protection, to attract prey or a mate.

Name:

#4

Define "triboluminescence" in your own words.

e.g. Light from friction

↳ light that appears when objects are rubbed together

Name:

#6

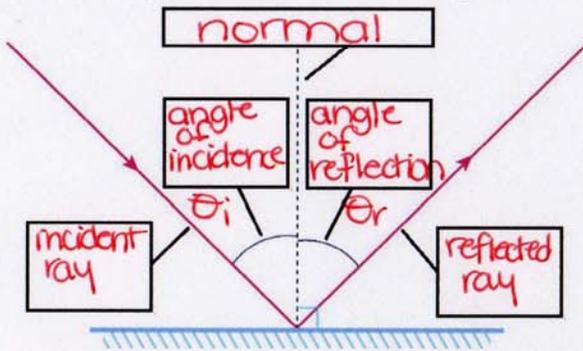
How do light-emitting diodes (LEDs) work? Explain in your own words.

e.g. LEDs use semi-conductors to create light. When electricity passes through the LED photons are emitted. The color of the light depends on the energy of the photon.

Name:

#7

Label the 5 parts of this diagram.



Name:

#9

If the angle of incidence is 37° , the angle of reflection is 37° .

If the angle of reflection is 15° , the angle of incidence is 15° .

If the angle between the normal and incident ray is 28° , the angle of reflection is 28° .

If the angle between the mirror and the incident ray is 50° , the angle of reflection is 40° .

Name:

#8

State the two Laws of Reflection.

- ① The angle of incidence is equal to the angle of reflection.
- ② The incident ray, reflected ray & normal all lie on the same plane.

Name:

#20

If you were to go for a hike along a still lake, would you see specular or diffuse reflection. Explain.

Since the lake is still, it acts like a plane mirror
 \therefore the reflection would be specular.

Name:

#21 Use the Laws of Reflection to draw the mirror image of the object.

EYE | EYE

Name:

#23 Use the Laws of Reflection to draw the mirror image of the object.

WOW

MOM

Name:

#22 Use the Laws of Reflection to draw the mirror image of the object.

SCIENCE | SCIENCE

Name:

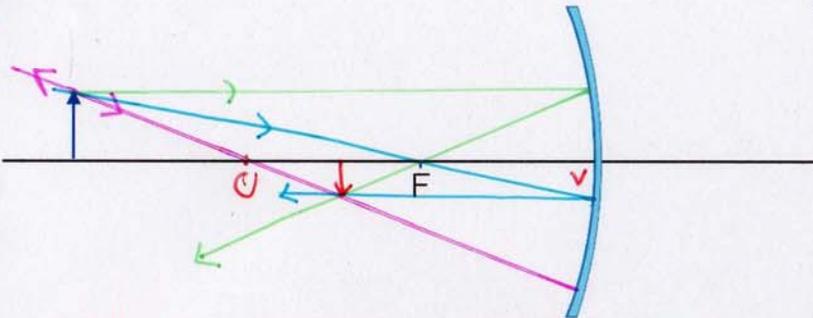
#24 Use the Laws of Reflection to draw the mirror image of the object.

COOKIE

COOKIE

Name:

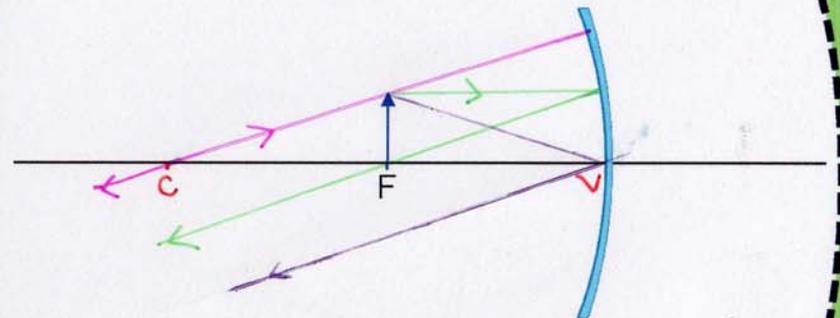
#25 Measure and label C, then draw at least 3 rays to determine the SALT of the image.



S smaller A inverted L between C&F T real

Name:

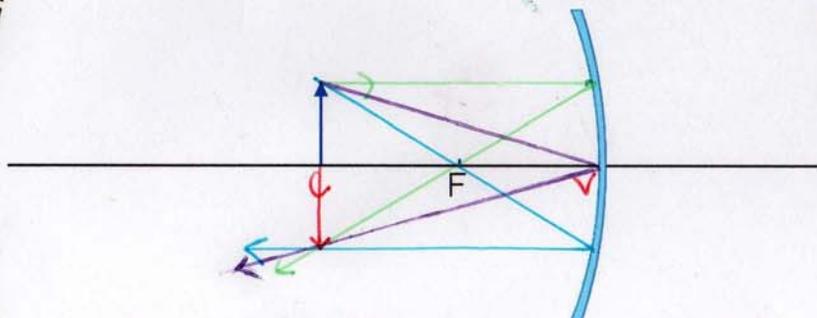
#27 Measure and label C, then draw at least 3 rays to determine the SALT of the image.



S A L T
No image (parallel rays)

Name:

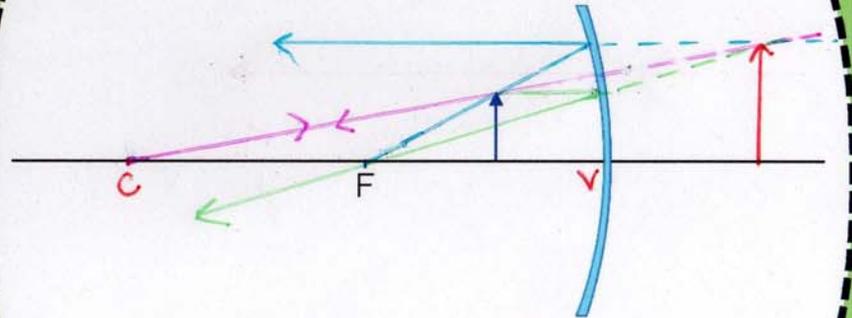
#26 Measure and label C, then draw at least 3 rays to determine the SALT of the image.



S same size A inverted L at C T real

Name:

#28 Measure and label C, then draw at least 3 rays to determine the SALT of the image.

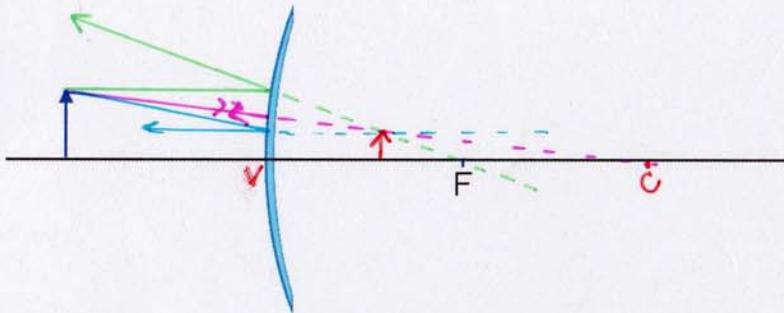


S larger A upright L inside the mirror T virtual

Name:

#29

Measure and label C, then draw at least 3 rays to determine the SALT of the image.

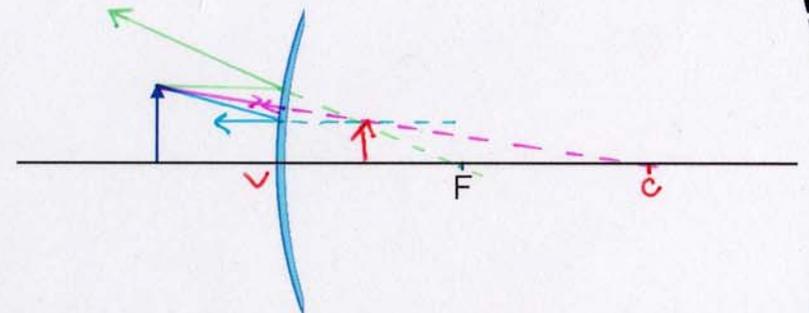


S smaller A upright L inside the mirror T virtual

Name:

#31

Measure and label C, then draw at least 3 rays to determine the SALT of the image.

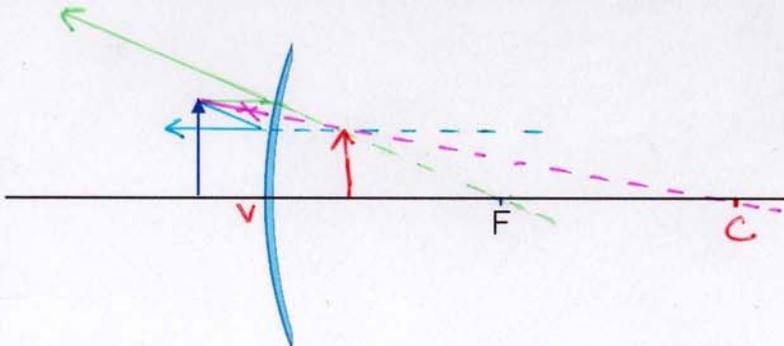


S smaller A upright L inside the mirror T virtual

Name:

#30

Measure and label C, then draw at least 3 rays to determine the SALT of the image.

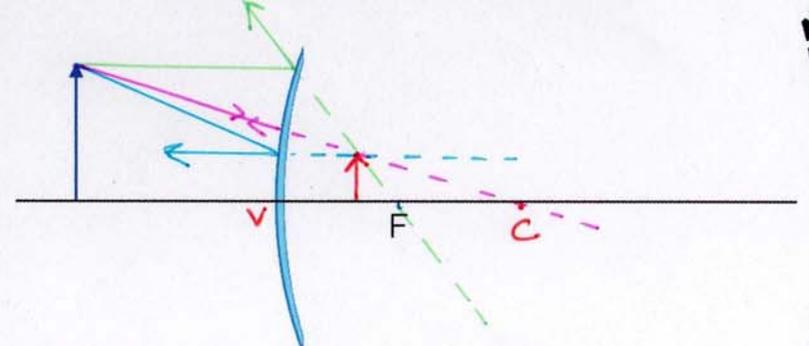


S smaller A upright L inside the mirror T virtual

Name:

#32

Measure and label C, then draw at least 3 rays to determine the SALT of the image.



S smaller A upright L inside the mirror T virtual

Name:

#33

Use your own words to define "refraction".

Refraction is the bending of light when it changes media - either going faster or slower.

Name:

#35

What causes the refraction of light?

Refraction is caused by the change in speed of light as it changes media.

Name:

#34

State the two rules for refraction.

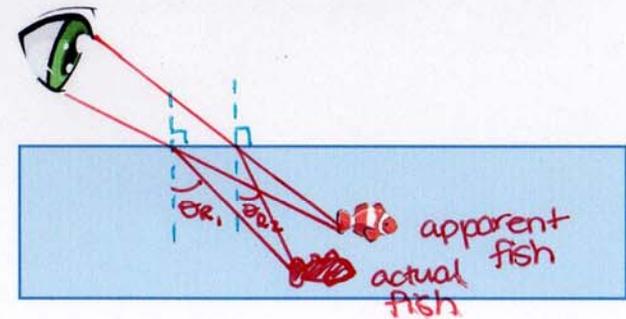
① The incident ray, refracted ray and normal all lie on the same plane. The incident ray and refracted ray are on opposite sides of the line that separates the two media.

② Light bends towards the normal when it slows down ($n_1 < n_2$) and bends away from the normal when it speeds up ($n_1 > n_2$)

Name:

#36

Using your understanding of refraction, draw the actual location of the fish.



Name:

#37

Calculate the speed of light in glass.

$$n_{\text{glass}} = 1.52$$

$$v = \frac{c}{n}$$

$$v = \frac{3.00 \times 10^8 \text{ m/s}}{1.52}$$

$$v = 1.97 \times 10^8 \text{ m/s}$$

∴ The speed of light in glass is $1.97 \times 10^8 \text{ m/s}$.

Name:

#39

Calculate the speed of light in ice.

$$n_{\text{ice}} = 1.31$$

$$v = \frac{c}{n}$$

$$v = \frac{3.00 \times 10^8 \text{ m/s}}{1.31}$$

$$v = 2.29 \times 10^8 \text{ m/s}$$

∴ The speed of light in ice is $2.29 \times 10^8 \text{ m/s}$.

Name:

#38

Calculate the index of refraction of salt.

$$v_{\text{salt}} = 1.96 \times 10^8 \text{ m/s}$$

$$n = \frac{c}{v}$$

$$n = \frac{3.00 \times 10^8 \text{ m/s}}{1.96 \times 10^8 \text{ m/s}}$$

$$n = 1.53$$

∴ The index of refraction of salt is 1.53.

Name:

#40

Your friend calculates the index of refraction of diamond to be 0.41. Is this answer reasonable? Explain.

This is not reasonable, because n_{diamond} must be greater than 1.00. This value of 0.41 indicates that light would be travelling faster than $3.00 \times 10^8 \text{ m/s}$ in diamond - this is impossible. (Friend used $n = \frac{v}{c}$ instead of $n = \frac{c}{v}$)

Name:

↑ incorrect eqn.

#41

Define "critical angle" in your own words.

The angle of incidence (always in the slower medium) that causes the angle of refraction to be 90° in the faster medium.

Name:

#43

Explain why diamonds sparkle so much.

Diamonds are cut in strategic ways, that when coupled with their high index of refraction, causes lots of light to be trapped inside. The low critical angle of diamond means most light experiences T.I.R. multiple times before escaping.

Name:

#42

Describe the two conditions that need to be met for total internal reflection to occur.

- ① Light must be travelling from a slower to a faster medium.
- ② The angle of incidence must be greater than the critical angle.

Name:

#44

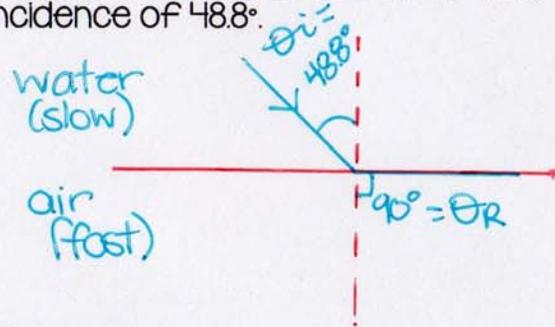
How do fiber optic cables work?

Fiber optic cables use total internal reflection to trap light inside the cable. The light carries information for phones, computers and TVs.

Name:

#45

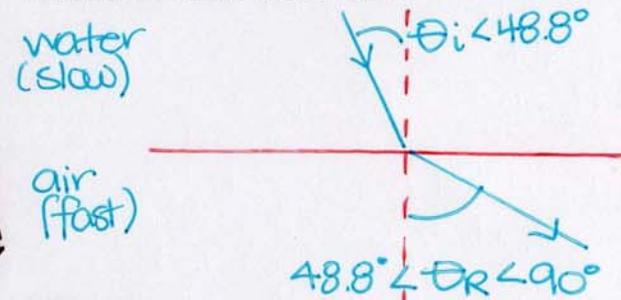
The critical angle of water is 48.8° . Draw a diagram to show the path of the light if it travels from water into air at an angle of incidence of 48.8° .



Name:

#47

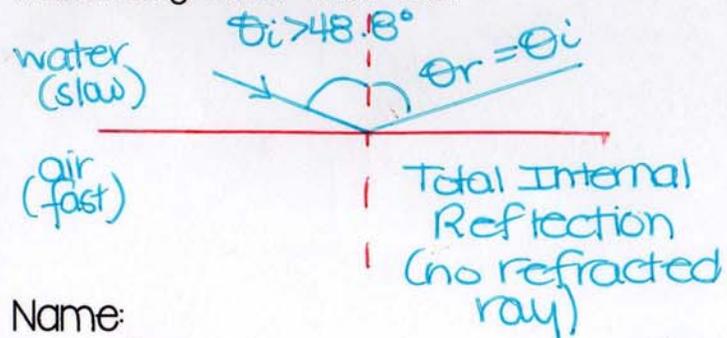
The critical angle of water is 48.8° . Draw a diagram to show the path of the light if it travels from water into air at an angle of incidence less than 48.8° .



Name:

#46

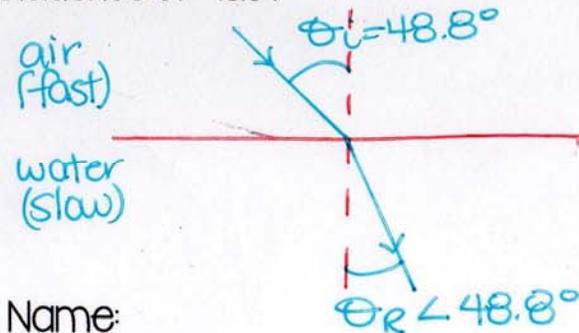
The critical angle of water is 48.8° . Draw a diagram to show the path of the light if it travels from water into air at an angle of incidence greater than 48.8° .



Name:

#48

The critical angle of water is 48.8° . Draw a diagram to show the path of the light if it travels from air into water at an angle of incidence of 48.8° .



Name:

#49

Could total internal reflection occur in these situations? Circle the correct answer.

- a) Light travels from air to ice. Yes/No
- b) Light travels from ice to air. Yes/No
- c) Light travels from glass to water. Yes/No
- d) Light travels from diamond to ice. Yes/No
- e) Light travels from ice to water. Yes/No

$n_{\text{air}} = 1.00$, $n_{\text{ice}} = 1.31$, $n_{\text{water}} = 1.33$, $n_{\text{glass}} = 1.52$, $n_{\text{diamond}} = 2.42$

Name:

#51

Explain how a retro-reflector can keep athletes safe at night?

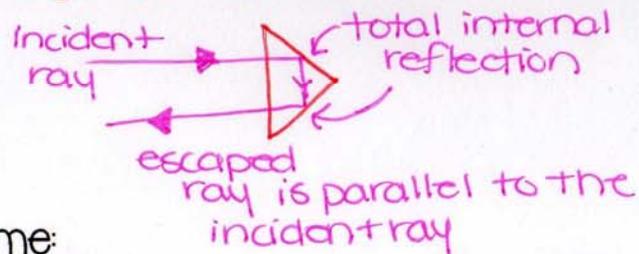
If the athlete (biker or runner) had a retro-reflector on them or their equipment, then any light from an on-coming car would be reflected back to the driver. The driver would be able to see the athlete & not hit the athlete.

Name:

#50

What is a "retro-reflector"? How does it work?

A device that sends light back to its source using total internal reflection.

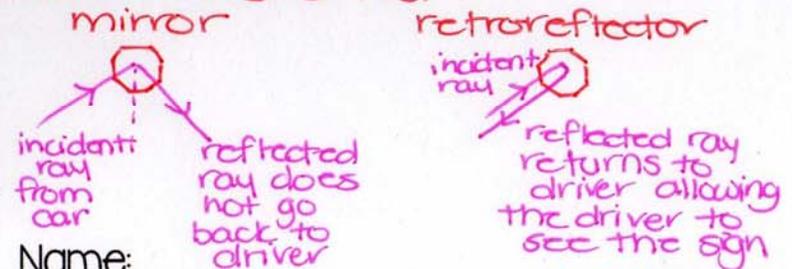


Name:

#52

What would happen if street signs used mirrors instead of retro-reflectors? Include a diagram.

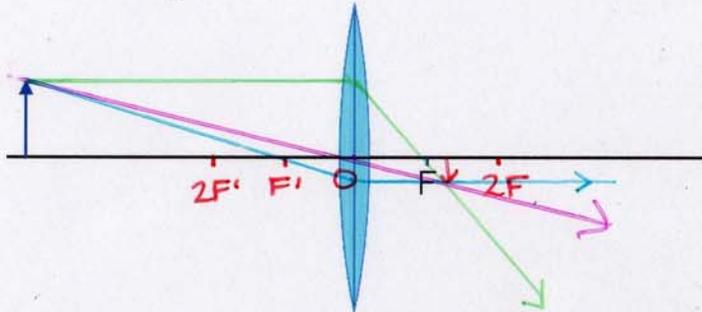
The reflected light would not reach the driver:



Name:

#53

Measure and label $2F$, F and $2F'$, then draw at least 3 rays to determine the SALT of the image.

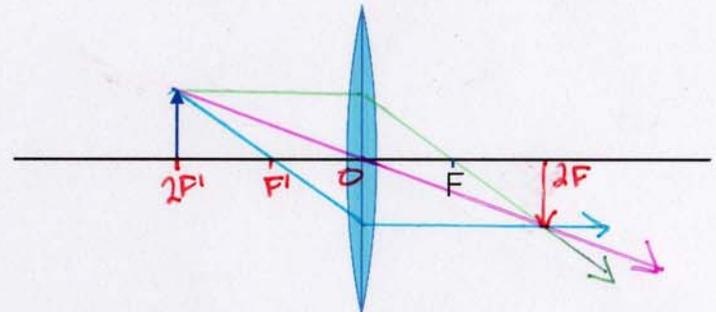


S smaller A inverted L between F & $2F$ T real

Name:

#55

Measure and label $2F$, F and $2F'$, then draw at least 3 rays to determine the SALT of the image.

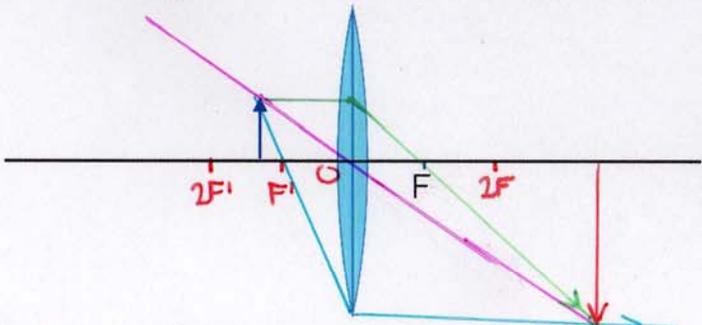


S same size A inverted L at $2F$ T real

Name:

#54

Measure and label $2F$, F and $2F'$, then draw at least 3 rays to determine the SALT of the image.

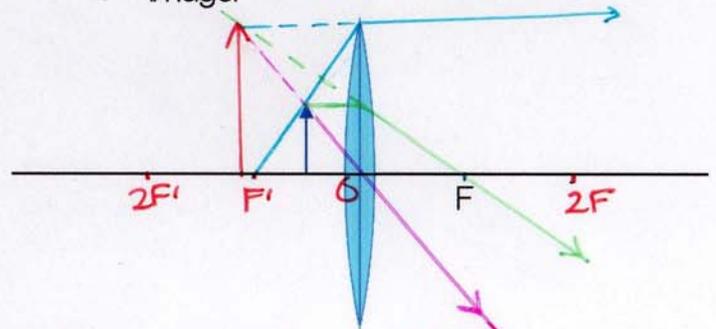


S larger A inverted L beyond $2F$ T real

Name:

#56

Measure and label $2F$, F and $2F'$, then draw at least 3 rays to determine the SALT of the image.

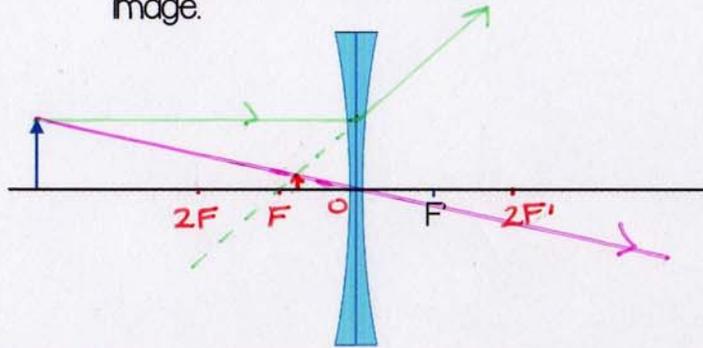


S larger A upright L same side as object T virtual

Name:

#57

Measure and label $2F$, F and $2F'$, then draw at least 3 rays to determine the SALT of the image.

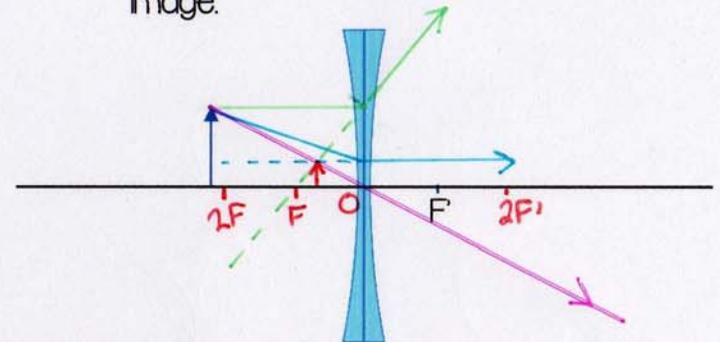


S smaller A upright L same side as object T virtual

Name:

#59

Measure and label $2F$, F and $2F'$, then draw at least 3 rays to determine the SALT of the image.

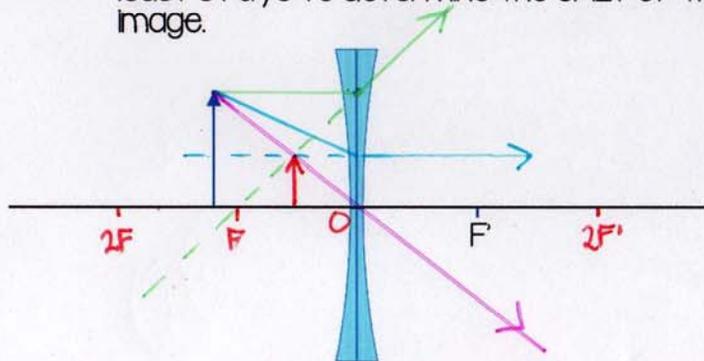


S smaller A upright L same side as object T virtual

Name:

#58

Measure and label $2F$, F and $2F'$, then draw at least 3 rays to determine the SALT of the image.

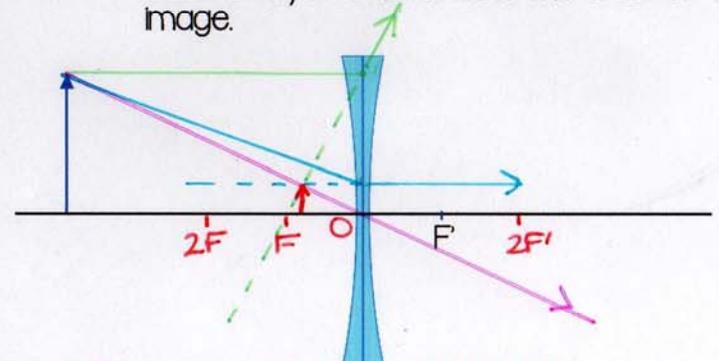


S smaller A upright L same side as object T virtual

Name:

#60

Measure and label $2F$, F and $2F'$, then draw at least 3 rays to determine the SALT of the image.



S smaller A upright L same side as object T virtual

Name:

#61

Match the camera parts to the correspond eye part with a similar function.

Camera Part
a) Diaphragm
b) Aperture
c) Film
d) Lens

Eye part
d Cornea
c Retina
a Iris
b Pupil

Name:

#63

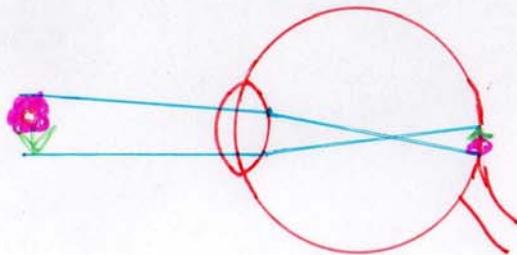
Images that appear on the retina are smaller, real and inverted. Explain why we don't see the world as inverted.

The image from the retina is sent through the optic nerve to the brain. The brain flips the image so that we see the world upright.

Name:

#62

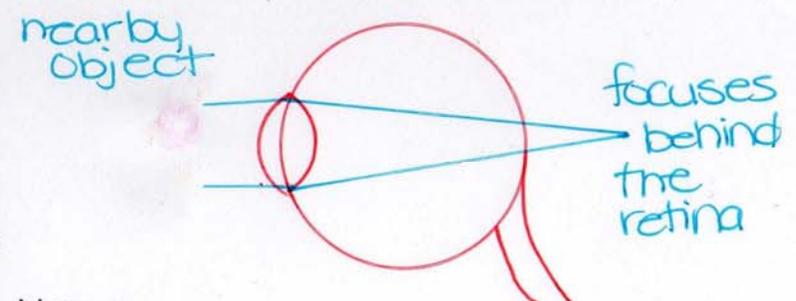
Draw a diagram to show how a healthy eye produces an image on the retina.



Name:

#64

Draw a diagram of an eye to show where the image of a nearby object focuses for a far-sighted person.

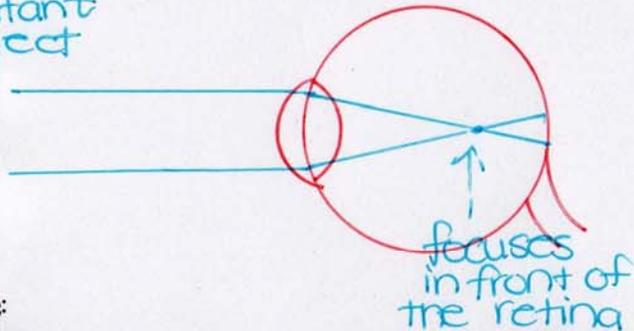


Name:

#65

Draw a diagram of an eye to show where the image of a far object focuses for a near-sighted person.

distant object

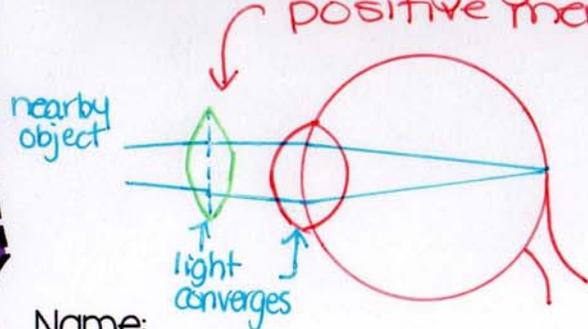


Name:

#66

Draw a diagram of an eye to show how a lens can fix hyperopia. What type of lens is used?

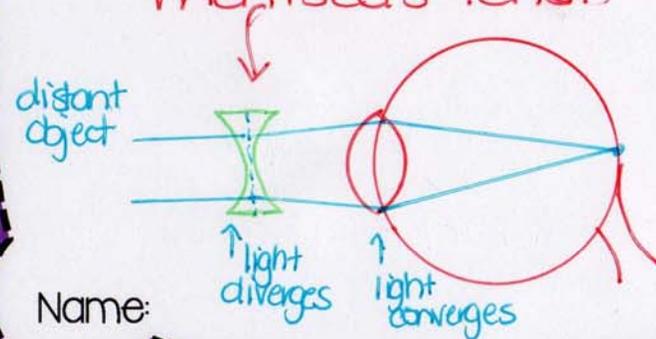
converging or positive meniscus lens



Name:

#67

Draw a diagram of an eye to show how a lens can fix myopia. What type of lens is used? diverging or negative meniscus lens.



Name:

#68

Fill in the blanks:

Hyperopia is also called far-sightedness.
 This occurs when the light from nearby objects focuses behind the retina. It can be solved using a converging lens.
 Myopia is also called near-sightedness.
 This occurs when the light from distant objects focuses in front of the retina. It can be solved using a diverging lens.

nearby, distant, in front of, behind, converging, diverging, far-sightedness, near-sightedness

Name: