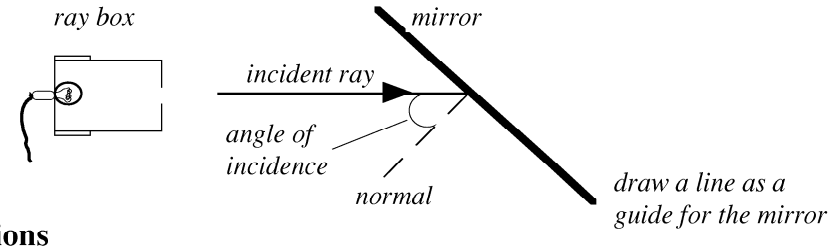
PHYSICS
Intermediate 1
Radiations

ACTIVITY 1

Title: Reflection from a plane mirror.

Aim: To investigate the relationship between the angle of incidence and the angle of reflection for a plane mirror.

Apparatus: 12 V power supply, ray box, single slit, plane mirror and protractor.



Instructions

- Draw a straight line on a sheet of paper to act as a guide for lining up the mirror. Draw a dotted line at right angles to it. This dotted line is called the normal and is the line from which the angle of incidence and angle of reflection are measured.
- Draw in lines at 10º, 30º, 60º and 80º from the normal. These will act as guides for the incident rays.
- Carefully line up a beam of light from the ray box along the first of these lines, making sure that the centre of the ray runs along the line. Mark the position of the reflected ray.
- Measure the angle of reflection between the reflected ray and the normal and record it in a table like the one shown.
- Repeat for the other angles.
- What conclusion can you draw about the relationship between the angle of incidence and the angle of reflection?

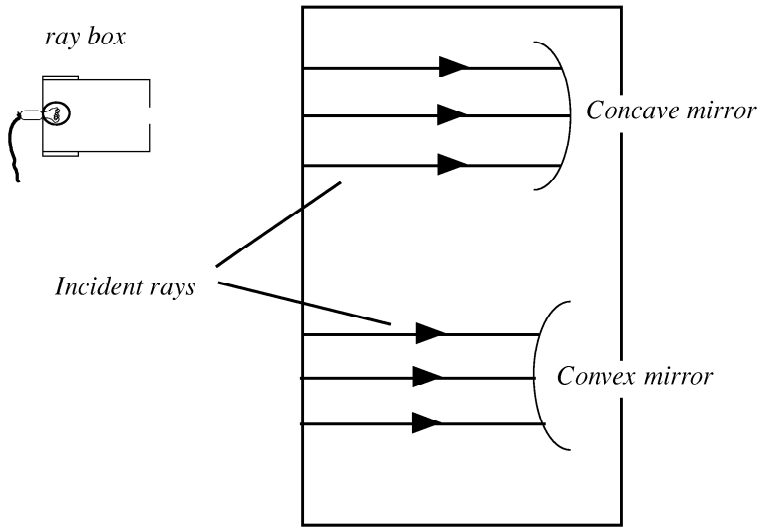
Angle of incidence (degrees)	Angle of reflection (degrees)
10	
30	
60	
80	

ACTIVITY 2

Title: Curved Mirrors.

Aim: To study how light reflects from a curved mirror.

Apparatus: 12 V power supply, ray box, triple slit, concave and convex mirrors.



Instructions

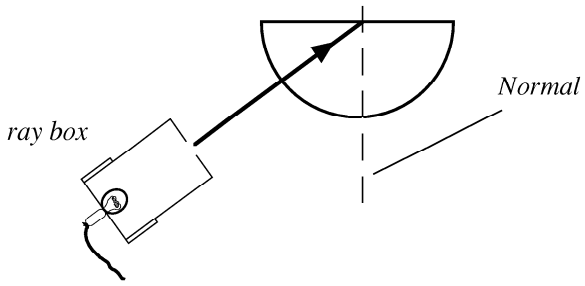
- Set up the apparatus as shown.
- Mark the position of each mirror and the incident rays.
- Draw in the path of the reflected rays.
- Describe what effect each mirror has on the parallel rays.
  (State whether the mirror brings the rays to a focal point or whether it spreads the light rays out.)

ACTIVITY 3

Title: Reflection inside a glass block.

Aim: To investigate total internal reflection of light.

Apparatus: 12 V power supply, ray box, single slit, semi circular block.



Instructions

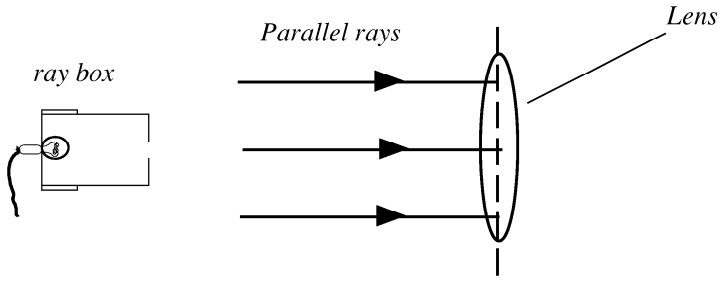
- Draw round your semicircular block.
- Draw a normal line in the middle of the flat side as shown.
- Direct a ray of light at 30º to the normal. Mark the rays you see, then draw them in fully.
- Now repeat but this time for an angle of 60º. Mark any rays and draw them in fully.
- Comment on the difference between these two cases (think about the aim of this experiment).
- Find the angle of incidence at which this effect first happens.

ACTIVITY 4

Title: Refraction of light in a converging lens.

Aim: To investigate refraction of light in two converging lenses of different thicknesses.

Apparatus: 12 V power supply, ray box, triple slit, two lenses of different focal length (one fat, one thin).



Instructions

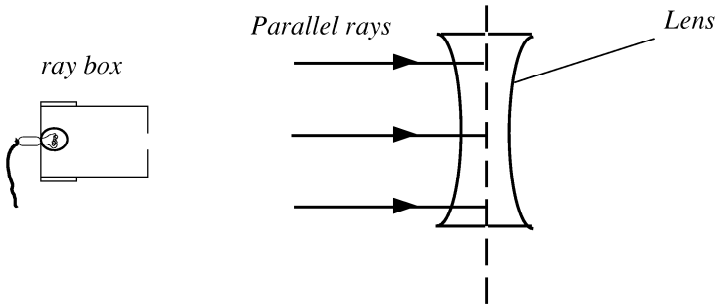
- Draw a dotted line on your paper to line up the centre of the lens and draw round the lens.
- Direct parallel rays towards the lens as shown above.
- Mark the paths taken by the rays before and after entering the lens.
- Describe what the lens has done to the parallel rays.
- Repeat this for the other lens and describe any differences.
- What conclusion can you make from this experiment?

ACTIVITY 5

Title: Refraction in a diverging lens.

Aim: To investigate the refraction of light of a diverging lens.

Apparatus: 12 V power supply, ray box, triple slit, concave lens.



Instructions

- Draw a dotted line on your paper to line up the centre of the lens and draw round the lens.
- Direct parallel rays towards the lens as shown above.
- Mark the paths taken by the rays before and after entering the lens.
- Describe what the lens has done to the parallel rays.
- What differences are there between this diverging lens and the converging lens used in Activity 4?

ACTIVITY 6

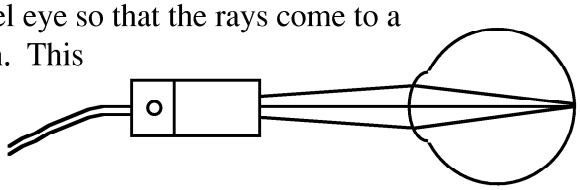
Title: Eye defects.

Aim: To investigate long sight.

Apparatus: 12 V power supply, ray box, triple slit, model eye, converging lens.

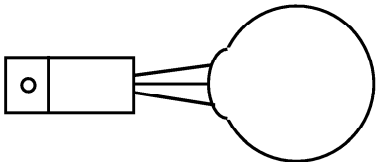
Instructions

- Set up the ray box and model eye so that the rays come to a focus on the retina as shown. This represents normal sight.

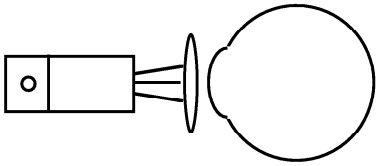


- Move the ray box closer to the eye, this is like light from a close object.

- Copy and complete the diagram showing what happens to the rays. This represents someone with long sight.



- To correct long sight, place a converging lens in front of the eye to bring the rays back to a focus on the retina. Copy and complete the diagram to show this.



- Write a brief note explaining why a long sighted person cannot see close up objects clearly and how this can be corrected.

ACTIVITY 7

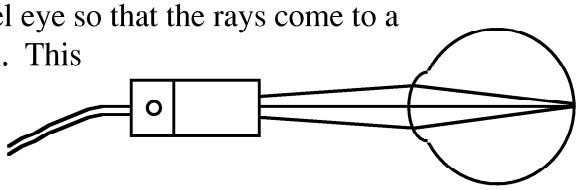
Title: Eye defects.

Aim: To investigate short sight.

Apparatus: 12 V power supply, ray box, triple slit, model eye, diverging lens.

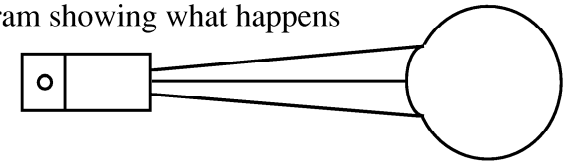
Instructions

- Set up the ray box and model eye so that the rays come to a focus on the retina as shown. This represents normal sight.

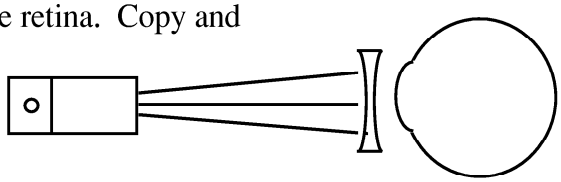


- Move the ray box farther from the eye, this is like light from a distant object.

- Copy and complete the diagram showing what happens to the rays. This represents someone with short sight.



- To correct short sight, place a diverging lens in front of the eye to bring the rays back to a focus on the retina. Copy and complete the diagram to show this.



- Write a brief note explaining why a short sighted person cannot see distant objects clearly and how this can be corrected.

ACTIVITY 8

Outcome 3 ✔

Obtaining Information on X-Rays.

Instructions

- Use a separate sheet of paper to prepare your report.
- Gather together the sources of information you have, you may have access to a library or the Internet.
- State a title for your report.
- Try to think about what you might write about.
  Who discovered X-rays and when?
  How are they different from light?
  What are their properties?
  How are they made?
  What uses are they put to?
- List all your sources including any Internet address used.
- You might want to use this as an **OUTCOME 3 ASSESSMENT.** If you do, use a **Report Sheet.**

ACTIVITY 9

Examining and Describing X-ray Photographs.

Instructions

- Use a separate sheet of paper for your report.
- You should collect a range of X-ray photographs.
- For two different X-rays describe what is the X-ray.
  Describe the bones, are they the same density at all points?
  Are there any signs of fractures? Can you make out any soft tissue (muscle or skin)? Is there any sign of man made objects eg. jewellery, fillings, plates or pins in bones?
- Try to draw a simple sketch of what you see.

ACTIVITY 10 **Outcome 3** ✔

Obtaining Information on Industrial Uses of X-rays.

Instructions

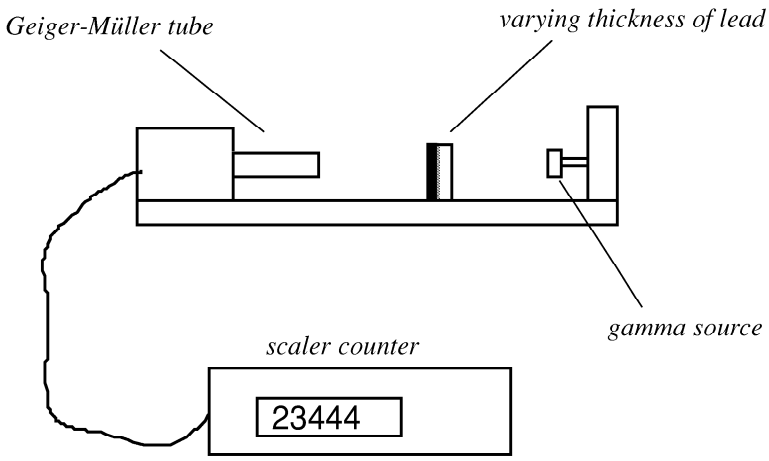
- Use a separate sheet of paper for your report.
- Gather together the sources of information you have, you may have access to a library or the Internet.
- State a title for your report. This will depend on what use you describe.
- Write a few paragraphs about this use. Try to give as much information as possible and if you can, compare the strength of the X-rays with those used in medicine. How are workers protected from these X-rays?
- List all your sources including any Internet address used.
- You might want to use this as an **OUTCOME 3 ASSESSMENT.** If you do, use a **Report Sheet**.

ACTIVITY 11

Title: The Absorption of Gamma Rays.

Aim: To investigate the absorption of Gamma Rays by varying the thickness of lead absorber.

Apparatus: Geiger-Müller tube, scaler, lead blocks, gamma source, stopclock.



Instructions

- Watch the demonstration experiment, taking down the results in a table.
- You will need to draw a graph of these results with the radioactive count on the vertical axis and the thickness of lead on the horizonal axis.
- If time permits your teacher may ask you to find more out from the graph.
- Write up this experiment and include safety procedures.

ACTIVITY 12

Title: Measuring Background Radiation

Aim: To measure the number of counts per minute in the laboratory.

Apparatus: Geiger-Müller Tube, scaler, stopwatch or automatic scaler.

Instructions

- Measure the number of counts over twenty minutes note the result and work out the background count in counts per minute.
- Explain in your report why this long time period was used to find the number of counts in one minute.

ACTIVITY 13

Outcome 3 ✔

Obtaining Information on:

- **use of gamma rays to treat cancer**
- **use of gamma rays to sterilise medical instruments**
- **precautions for handling radioactive substances.**

Instructions

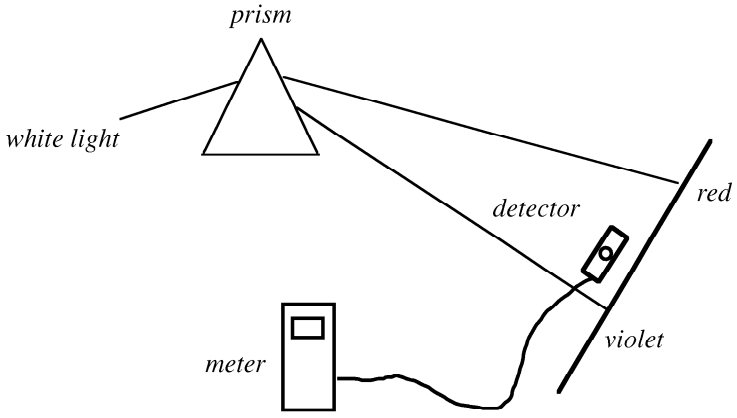
- Use a separate sheet of paper to prepare your report.
- Gather together the sources of information you have, you may have access to a library or the Internet.
- State a title for your report.
- Try to think about what you might write about.
- Once you have gathered your information choose the area you are most interested in or have the most material on. Write a detailed report on this including any diagrams which you consider helpful.
- List all your sources including any Internet address used.
- You might want to use this as an **OUTCOME 3 ASSESSMENT.** If you do, use a **Report Sheet**.

ACTIVITY 14

Title: Detecting Infrared Radiation.

Aim: To use an infrared detector and demonstrate that IR radiation is invisible.

Apparatus: Light source, prism, infrared detector, gauze, bunsen and tongs.



Instructions

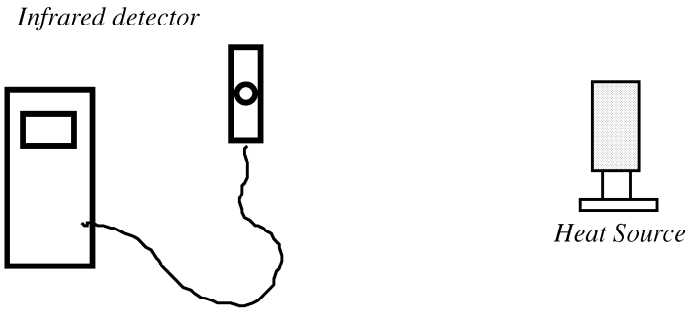
- Using the tongs, heat the gauze in the bunsen flame until it glows red hot.
- Take it out and let it cool until the red glow just disappears.
- Hold the gauze in front of the radiation sensor. Note how the detector reading changes when the gauze is brought close to it.
- Now take the detector to the spectrum from white light and take readings for violet, yellow and red light. Is the detector sensitive to light?
- Move the detector beyond the red. Note the reading on the meter. Explain why the meter reading changes beyond the red end of the spectrum.

ACTIVITY 15

Title: Absorbing Infrared Radiation.

Aim: To investigate the absorption of infrared radiation.

Apparatus: Infrared heat source, infrared detector, various materials such as sheet of paper, book, hand, glass block, perspex, wood.



Instructions

- Adjust the detector position in front of the heater (not too close!) to obtain a large reading on the meter. Note down this reading.
- Now place each of the materials in turn in front of the heater and note the readings obtained in a table similar to the one shown.

Material	Reading
Paper	
Book	
Hand	
Glass	
Perspex	
Wood	

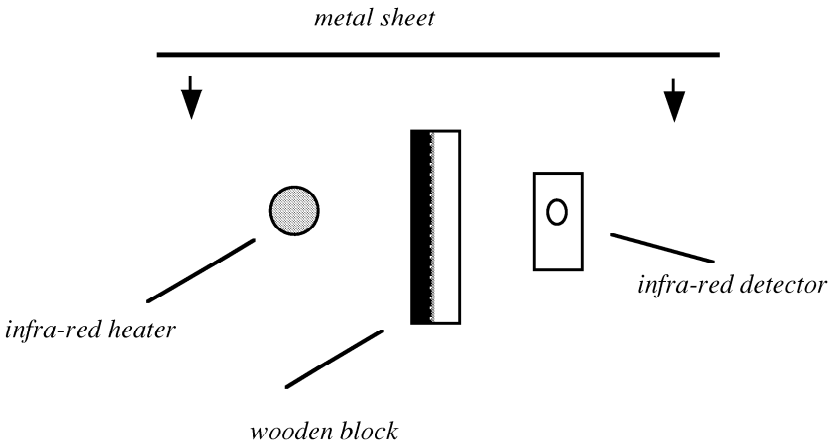
- Write your report and include sentences saying " Most of the infrared radiation is absorbed by ....." and " Some of the infrared radiation is absorbed by .....".
- How can you tell that your hand absorbs infrared radiation?

ACTIVITY 16

Title: Reflecting Infrared Radiation.

Aim: To investigate reflection of infrared radiation.

Apparatus: Infrared heat source, infrared detector, wooden block, metal sheet.



Instructions

- Adjust the detector position in front of the heater (not too close!) to obtain a large reading on the meter.
- Now slide the wooden block between them as shown in the diagram
- Now quickly slide the polished metal towards the block and watch for any change in reading, note any change.
- Try repeating for another reflecting surface does it need to be shiny to reflect?
- Is there any evidence to suggest that infrared radiation reflects like light?
- Try rotating the metal sheet and note any changes in reading.

ACTIVITY 17

Outcome 3 ✔

Obtain information on the uses of infrared radiation, for example thermograms, infrared cameras, night sights, heat lamps. These might be in the home, in industry, medicine or the emergency services.

Instructions

- Use a separate sheet of paper to prepare your report.
- Gather together the sources of information you have, you may have access to a library or the Internet.
- State a title for your report.
- Try to think about what you might write about.
- Once you've gathered your information choose the area you are most interested in or have the most material on write a detailed report on this maybe including a diagram if it helps. If you like you could write about several different uses in different areas.
- List all your sources including any Internet address used.
- You might want to use this as an **OUTCOME 3 ASSESSMENT.** If you do, use a **Report Sheet**.

ACTIVITY 18

Title: Investigating Fluorescence and Ultraviolet.

Aim: To investigate some of the wide range of uses of fluorescent dyes.

Apparatus: Ultraviolet lamp, "Invisible ink" security marker, various banknotes, credit cards, security food seals, white shirt.

Instructions

- Use the ultraviolet lamp to examine each of the samples.
- Write a sentence about each and how it is used.
- Look at something with security markings on it, in day light.
  Try turning the object slightly, is the writing really invisible?
- Can you explain this?

ACTIVITY 19

Outcome 3 ✓

Obtain information on the uses of ultraviolet radiation, for example sun beds, treatment of acne, vitamin D deficiency, soap powders, security markers, insect destroying lamps for butchers etc.

Instructions

- Use a separate sheet of paper to prepare your report.
- Gather together the sources of information you have, you may have access to a library or the Internet.
- State a title for your report.
- Try to think about what you might write about.
- Once you've gathered your information choose the area you are most interested in or have the most material on write a detailed report on this maybe including a diagram if it helps. If you like you could write about several different uses in different areas.
- List all your sources including any Internet address used.
- You might want to use this as an **OUTCOME 3 ASSESSMENT.** If you do, use a **Report Sheet**.

LIGHT

Lasers

Sunlight looks white but it is made up of many colours combined together. A laser is a source of light that is made up of one single colour. A laser beam does not spread out - this means its energy is concentrated into a very small spot.

Practical Uses of Lasers

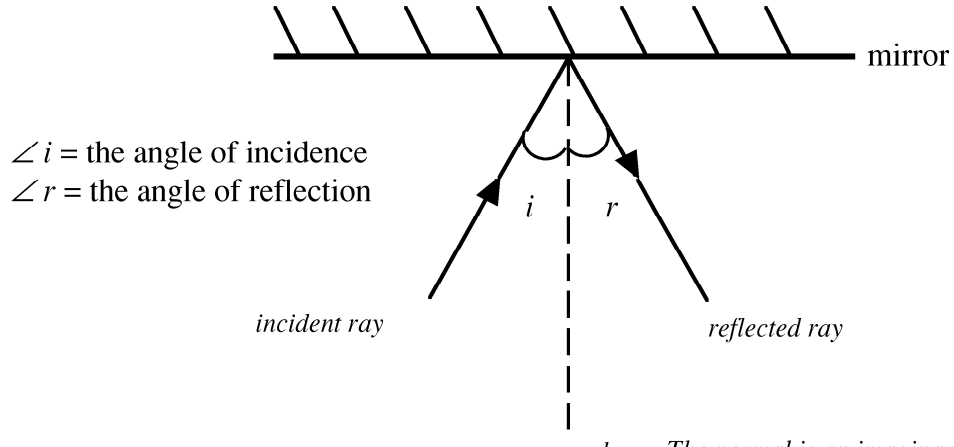
- Lasers are used to send information between businesses over the length of the country because it can carry a large amount of information at high speed.
- Lasers are used to repair damage to the retina at the back of the eye. A short pulse from the laser welds the retina back in place. There is no pain because the pulse lasts for such a short time.
- Lasers are used to vaporise cancerous tissue and tumours without scarring surrounding healthy tissue.

Visibility

An object is visible if you can see it. So either it sends out its own light which reaches your eye or it reflects light into your eye. An object which gives off its own light is called a source, eg the sun or a lightbulb.

Mirrors

Mirrors can be any shape, most are flat. A plane mirror is a flat mirror.

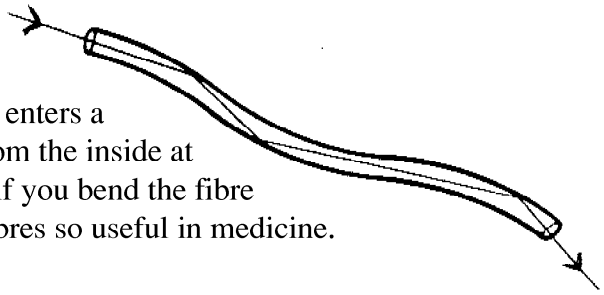


For any incident ray: $\angle i = \angle r$

i.e. Angle of incidence = Angle of reflection

The normal is an imaginary line at right angles (90°) to the surface. It is used as the "baseline" for measuring the angles of the rays.

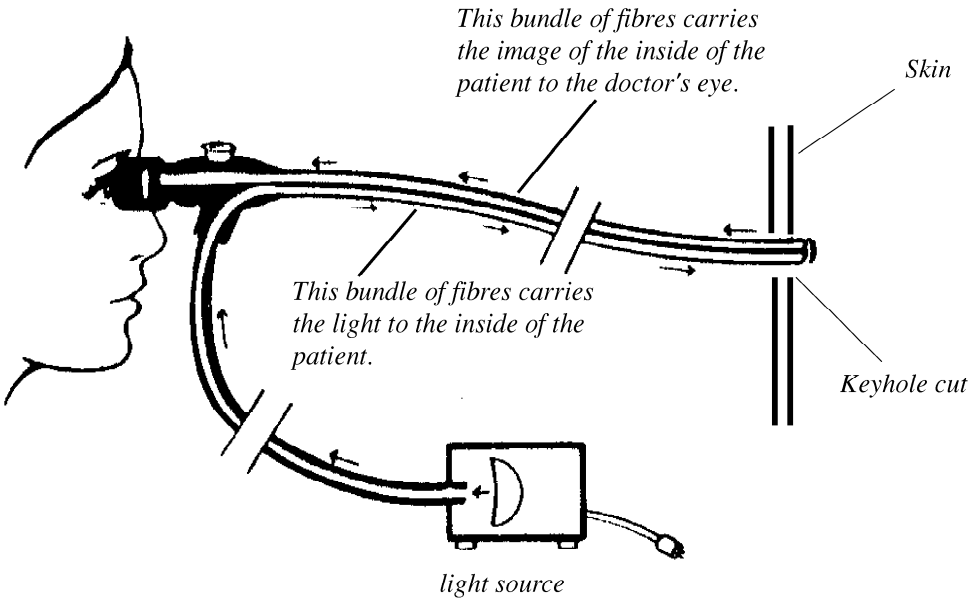
Optical Fibres



Optical fibres make use of the effect called total internal reflection. If light enters a very narrow glass fibre and reflects from the inside at large angles it does not escape. Even if you bend the fibre this still works. This is what makes fibres so useful in medicine.

The Fibrescope

The fibrescope is sometimes called an endoscope.
It has two separate bundles of very thin glass fibres. One bundle takes the light from the lamp down inside the patient using total internal reflection. The other bundle brings the light out using total internal reflection so the doctor can see inside the patient.

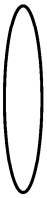
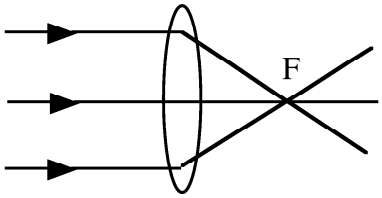
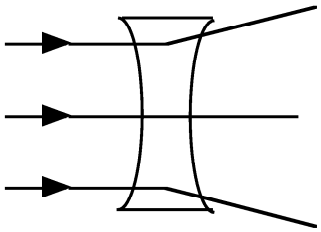


Why fibrescopes are useful

The fibrescope is used to see inside a patient without surgery. For example, a patient can have a stomach examination of an ulcer by passing the fibrescope down their throat. Without the fibrescope, the patient had to undergo surgery.

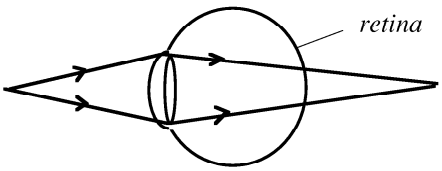
Using the fibrescope means the patient has reduced cutting of the skin, has less damage to healthy tissue and has a shorter recovery time.

Lenses

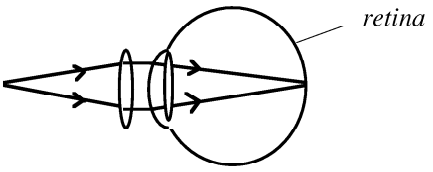
Lens	Shape	What it does	Diagram
Converging		It brings parallel rays to a point called the focus or focal point.	 F = Focal point
Diverging		It makes parallel rays of light spread out.	

Eye Defects

Long Sight



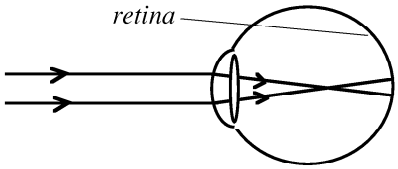
Someone who has long sight cannot read without glasses. The eye is not strong enough to bring rays from a nearby object to a focus inside the eye and the rays form a blurred image on the retina.



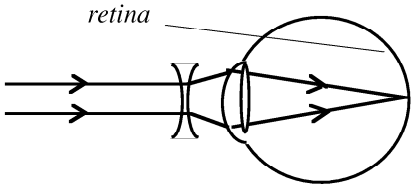
A converging lens is used to correct long sight. The diverging rays from close objects are made more parallel. The correct lens for the patient makes the rays form a sharp image on the retina.

A converging lens is used to correct long sight.

Short Sight



Someone who has short sight cannot see far away objects clearly without glasses. The eye brings rays from distant objects to a focus too early and the rays form a blurred image on the retina.

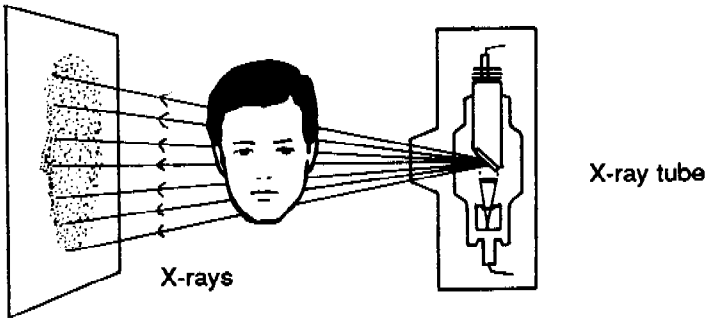


A diverging lens is used to correct short sight. The parallel rays from far objects are made to diverge. The correct lens for the patient makes the rays form a sharp image on the retina.

A diverging lens is used to correct short sight.

X-rays

X-rays are invisible to the naked eye. This means that even if they enter your eye you cannot detect them.



Photographic film is affected by X-rays and can be used to detect them.

When developed, the film shows dark patches where the X-rays have reached it.

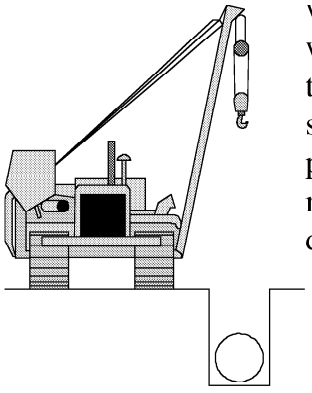
X-rays are dangerous because they can damage living cells.

Uses of X-rays

- X-rays are used in medicine. Skin, muscle and bone all absorb X-rays by different amounts and doctors use this fact to examine inside the bodies of patients. The X-rays can be given less energy to examine soft tissue like the brain.

- Radiographers and doctors who work with X-rays all day must be protected when they are operating the X-ray machine. They use lead screens to block the X-rays, they stand as far as possible from the machine and they wear special photographic film badges which monitor their exposure.

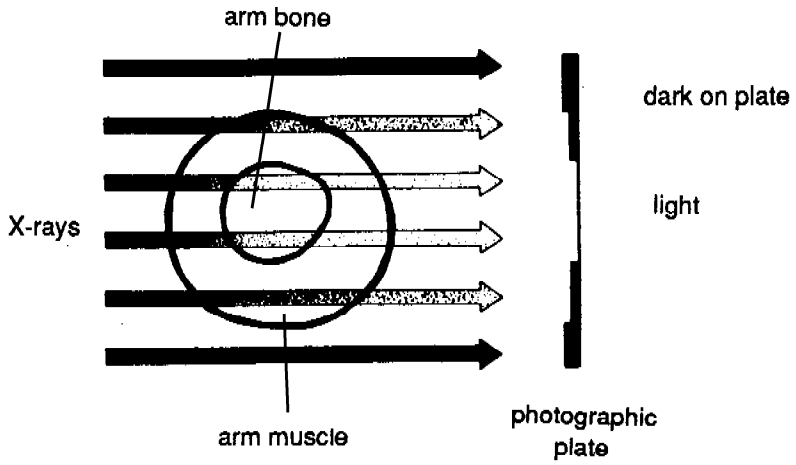
- X-rays are used in industry. Thick steel pipes can be made by rolling a steel plate into a cylinder and then welding a seam along the pipe. Although a weld might look perfect it can have small gaps that weaken it and can be disastrous. X-rays are used to study the weld to make sure there are no cracks. An X-ray source is placed outside the pipe and an X-ray detector is placed inside the pipe. Any cracks in the weld allow X-rays to pass through and show up as darker areas on the detector.



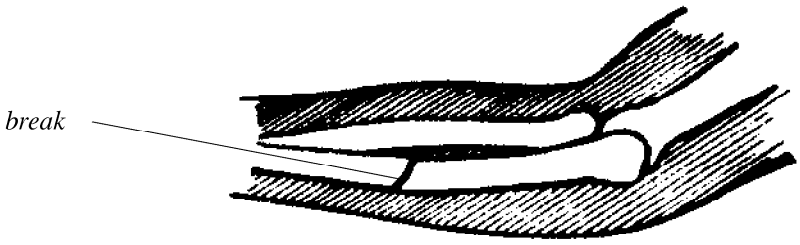
Using X-rays to check for a broken arm

X-rays can pass through muscle much easier than they can pass through bone. During an arm X-ray, the X-rays pass through the arm by different amounts - more for muscle, less for bone. The X-rays hit the photographic plate on the other side and blacken it.

The arm shows up as dark, with lighter areas for the bone.



A break in the bone lets X-rays through and shows up as a dark crack.



Gamma Rays

Like X-rays gamma rays are invisible to the naked eye. They are also dangerous as they can cause damage to living cells or change how they grow and work. They can pass through much thicker layers of most materials than X-rays (up to 20 cm of steel). This ability to damage living cells can be put to good use to help destroy cancer cells, and to kill all bacteria on medical instruments and materials.

Uses of Gamma Rays

- In medicine doctors often want to follow a particular chemical as it moves through the body to allow them to find anything unusual. They add a radioactive version of the chemical to the body. As it moves through the body the radioactive chemical can be followed using a detector outside the body. We call this chemical a radioactive tracer because we can trace its path. The strength of any source of gamma radiation decreases with time. In this application doctors have to be very careful the strength does not decrease too quickly or too slowly.

- In industry the penetrating power of gamma rays is also used to trace materials, often through pipelines. The strength of the source has to be very great so that the gamma rays get through the steel pipes and surrounding concrete and its strength usually has to remain high for longer as the pipelines can be very long.

Safety

The gamma rays from a source spread out in all directions. There are three ways of reducing the amount of radiation you absorb.

1. Stand as far away from a source as you can.
2. Spend as little time working with the source as possible
3. Put a thick lead shielding round a source.

NEVER touch a source with your hands and NEVER point it in the direction of someone.

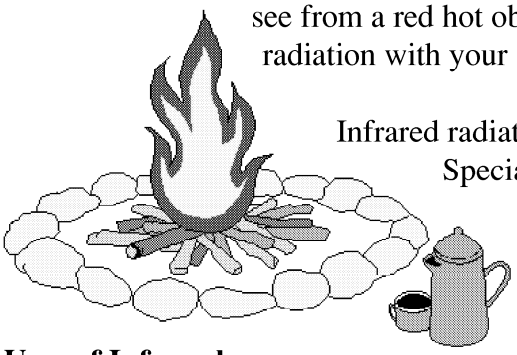
Radioactive Surroundings - Background Radiation

Whether we like it or not we are all exposed to radiation called background radiation:

- 50% is from radon and thoron gases in our houses
- 10% from our food, drink and breathing
- 10% from Outer Space

INFRARED (IR)

Like X-rays infrared (IR) rays are invisible to the naked eye. It is not the glow you see from a red hot object, that is light. You can feel infrared radiation with your skin.



Infrared radiation is sometimes called heat radiation. Special cameras called thermal imagers, which can detect infrared, are used to help find people in the dark or in smoke filled rooms.

Uses of Infrared

- In medicine heat photographs called thermograms are used to show up small temperature differences in the body. The different temperatures appear as different colours in the thermogram. Colder areas often mean poor blood supply while warmer areas are often the sign of a site of infection.

- In industry IR is used to dry things eg. biscuits, glues, paint on newly sprayed cars.

ULTRAVIOLET (UV)

Ultraviolet radiation (UV) cannot be detected by our eyes. It is invisible.

Ultraviolet radiation in medicine

Ultraviolet radiation is used to help treat skin conditions. Psoriasis is a severe form of rash which can be treated by chemicals which can harm healthy skin. Ultraviolet radiation shone over the affected areas switches on the chemical only where it is needed.

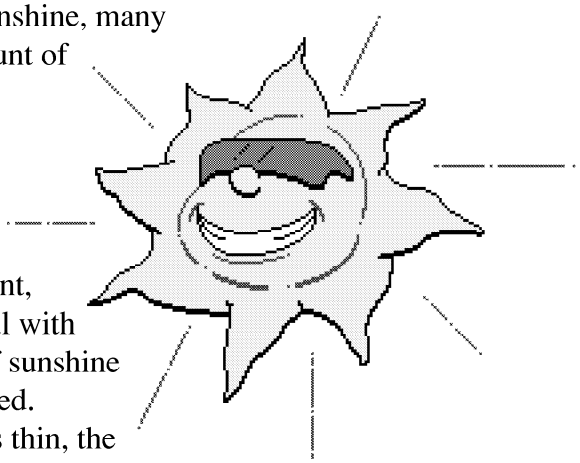
Fluorescence

Some chemicals glow and emit visible light when they absorb UV. This is used in shops to test credit cards and banknotes as they have codes marked on them that cannot be seen in normal light but glow under a UV lamp.

Industry puts fluorescent plastic food seals on some products to allow automatic checks for tampering. Soap powders also fluoresce. This is to make your clothes appear very bright and clean in sunlight (because sunlight contains UV).

Overexposure

When the skin is exposed to UV, it becomes tanned (suntan). If you spend too long in the sun or exposed to UV, your skin burns (sunburn). If you keep on exposing your skin to UV over several months, you may develop skin cancer. When going to countries where there is a lot of strong sunshine, many people use creams which reduce the amount of UV reaching the skin. These creams are given a "factor" number, the higher the factor, the less the UV exposure.



As the ozone layer gets thinner, more UV reaches the Earth's surface. At the moment, people in Australia have to be very careful with overexposure to UV since they get lots of sunshine and the ozone layer above them is damaged. Although the ozone layer above Britain is thin, the cloud cover keeps the UV down. Even so, people should use sun creams on sunny days.

RADIATIONS

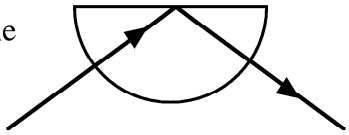
Light

1. A spotlight gives a very concentrated beam of light. What makes the light from a laser different from the spotlight beam?

2. The concentrated light from a laser means that it is very useful in all manner of industrial applications. Describe one application of the laser.

3. Laser light can also be switched on and off very rapidly. Give an example of the use of laser light in:
   a) shops
   b) the home
   c) telecommunications
   d) medicine.

4. Light can be completely reflected from the inside surface of glass. What condition needs to be met for this to happen?



5. Flexible strands of glass can also completely reflect light. This makes these fibres very useful in medicine. Give an example of the use of optical fibres in medicine. Explain how your example works.

6. There are two basic lens shapes. Name them and draw a diagram to show each shape. On a second diagram show the effect these lens shapes have on parallel rays of light and label any important feature.

7. Describe the eye defect called "short sight". You should use a diagram of the eye in your description.

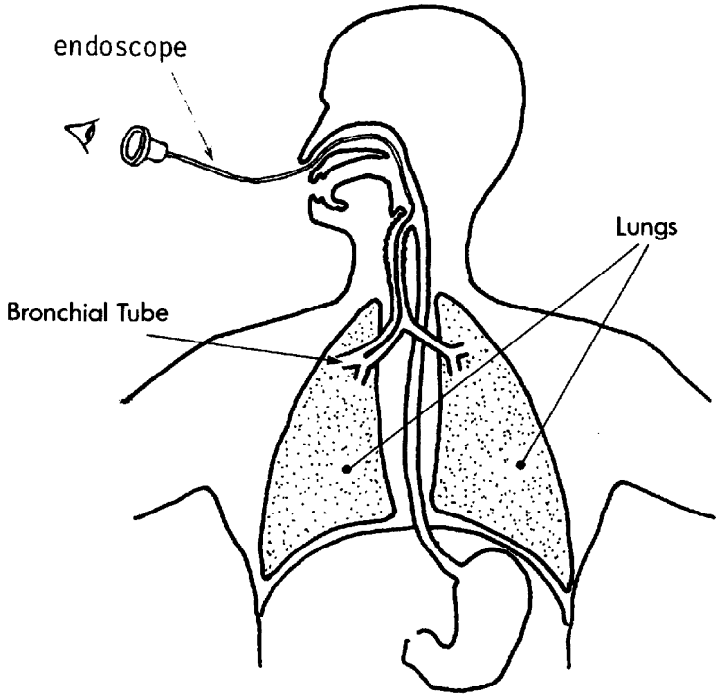
8. Joanne can see the cables clearly when she is wiring a plug. Joanne cannot see clearly the number plate on a far away car.

   (a) Would Joanne be described as long sighted, normal sighted or short sighted?

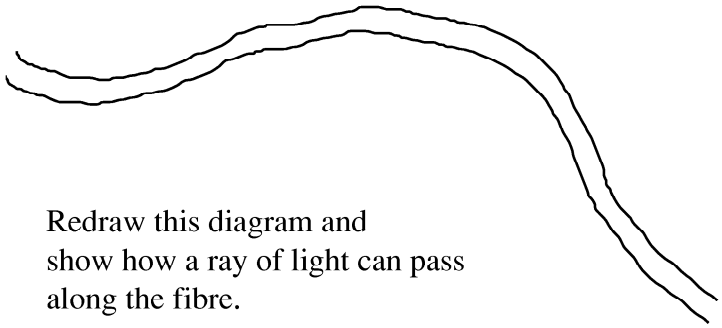
   (b) What kind of lens would Joanne need in her glasses, to correct her eye defect?

9. A man has to strain to read a newspaper. From which eye defect does he suffer?
   He decides he wants glasses to help him. What type of lens should be in the glasses?

10. An endoscope, using two bundles of optical fibres, may be used by a doctor to inspect the bronchial tubes of a patient as shown.



(a) The diagram below represents one section of an optical fibre in the endoscope.



Redraw this diagram and show how a ray of light can pass along the fibre.

(b) Explain how the optical fibres allow the doctor to see inside the patient's bronchial tube.

(SEB)

X-Rays

11. An X-ray tube is thought to be faulty. Why is it unlikely that looking into the tube will find out if it is working? Why should you advise against this?

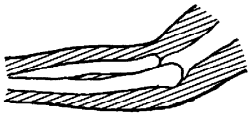
12. Give one way in which X-rays differ from light.

13. Write short notes describing two uses of X-rays.

14. At large airports, passengers must pass through an X-ray machine for security reasons. Signs warn travellers not to have camera film when they pass through. Why can the film be damaged?

15. An X-ray photograph of an arm is shown below.

    (a) Why does the bone appear as a lighter area and the tissue as a darker area in the photograph?
    (b) What difference would be seen on the photograph if there was a break in the bone?



(SEB 1989)

16. Industry also uses X-rays which tend to be much more energetic.

    a) Describe an example of the use of X-rays in industry and explain why such powerful X-rays are required.
    b) Give two reasons why such powerful X-rays are not used in medicine.

17. Why are X-rays dangerous?

18. Martin was in an accident and breaks a bone. To find the position of the break a doctor could use:

    (A) ultraviolet rays; (B) X-rays; (C) gamma rays.

    (i) Which of the above should the doctor use?
    (ii) Explain why **one** of the other rays would **not** have been suitable.

19. X-rays are used to take photographs of bones in the human body. To take a photograph of an arm bone (B), an X-ray machine (X) and a photographic film (F) are needed. In the boxes below, place B, X and F in the correct order to show their positions so that the photograph may be taken.

(SEB 1990)

Gamma Rays

20. Gamma rays can be used in the treatment of cancer and in the sterilisation of medical materials. In each case the same effect of gamma rays is being used. What is that effect?

21. Great care is needed when handling gamma sources.

    a) Explain why sources must only be handled with long forceps.
    b) Operators wear special film badges. What is the purpose of these badges?

22. Only very thick steel or lead offer any protection as a shield against a gamma radiation. Why do other materials not offer much protection?

23. In medicine chemicals which emit gamma rays are used to trace paths through the inside of the body.

    a) Why are gamma rays used for this purpose?
    b) Describe how doctors can map out the path taken by the chemical?
    c) The strength of a gamma source decreases with time. Why is this essential in this case?

24. Why is it not necessary to go to hospital or visit industry to be exposed to gamma rays?

25. What is meant by the term "background radiation"?

26. The table below gives the dose of radiation received by a patient in different medical examinations.

Source	**Dose/Unit**
Chest X-ray	30
Pelvic X-ray	300
Barium meal	1 000
Thyroid scan	16 400

    (a) In which examination does the patient receive the largest dose of radiation?
    (b) The maximum allowed dose in one year for a member of the public is 5000 units. How many barium meals can a patient be allowed in a year?
    (c) Why is the maximum dose a member of the public can receive limited by law?
    (d) One thyroid scan is much greater than the maximum dose allowed for a member of the public. Why are hospitals allowed to give such a large dose to one person?

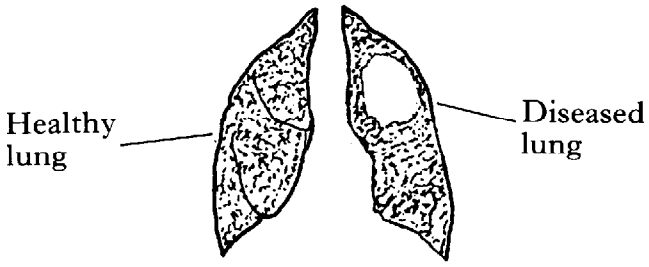
27. Two students are investigating the measured count rate from radioactive sources. They wish to find out how the measured count rate for a radioactive source changes with time. Their results are shown below. All the sources started with the same measured count rate.

Name of source	Time since start (minutes)	Measured count rate (counts per minute)
Radon	5	2 000
Thallium	5	3 200
Radon	10	70
Sodium	60	6 400
Radon	7	500

(a) Construct a new table, with headings and units, to show the results which the students should use to be able to make a conclusion for their investigation.

(b) What conclusion should the students make from their investigation?

28. A doctor injects a radioactive tracer into the blood stream to check the supply of blood reaching a patient's lungs. A radiation detector is used to build up a picture of the position of the tracer in the lungs. The diagram shows the picture obtained for a patient who has a healthy and a diseased lung.



(a) What information does the light area in the picture of the diseased lung give the doctor?

(b) Most of the radiation from the tracer passes through the body to the detector. Name the type of radiation emitted by the tracer.

(c) What will have happened to the activity of the tracer some time after the picture was taken?

(SEB 1989)

Infrared

29. A Bunsen gauze is heated until it is red hot. How would you prove to someone that the red glow is not infrared radiation but light?

30. Hot objects emit infrared radiation.

    a) How can you tell if an iron is hot without actually touching it.
    b) In what way are our bodies sensitive to infrared radiation?

31. Firefighters often have to enter smoke filled rooms to save people. Light is blocked completely by thick smoke. Describe how infrared sensing equipment can be used by the firefighter to detect unconscious people in such circumstances.

32. People who suffer from sore backs or who strain a muscle often use a heat lamp at home to relieve the pain. How does this work?

33. The heating effect of infrared radiation is often used in industry. Give one example of its use.

34. How is a thermogram different from what is seen in a night sight?

35. Describe a use of infrared heaters in kitchens and restaurants.

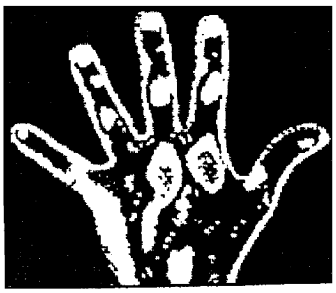
36. Some surfaces absorb infrared radiation better than others. The table below shows the percentage of infrared absorbed by different surfaces.

Surface	Percentage of infrared radiation absorbed (%)
Whitewashed wall	40
Red brick wall	70
Polished aluminium	25
Tar	90

(a) Draw a bar chart showing the percentage of infrared radiation absorbed and the surface.
(b) Which surface absorbed most infrared radiation?
(c) Which surface would you choose for the outer wall of a house in a very sunny country?
(d) Explain your answer to (c).

37. Read the following passage.

"Come on in, Chris," said the doctor. "We are going to take a thermogram of your hand."
"What's a thermogram?" asked Chris.
"Your body gives out radiation, called infrared," explained the doctor. "This is similar to light but it has a longer wavelength. We have a special camera which makes use of this radiation to take a photograph of your hand. The photograph is called a thermogram and is similar to the one shown in the diagram."
"What are the different patches in the photograph?" asked Chris.
"In a real thermogram," answered the doctor, "your hand will show up as patches of different colour. Each colour is due to a different temperature. The coldest parts are blue and the hottest parts are white. We can use the thermogram to detect unhealthy tissue since it is warmer than healthy tissue and so shows up as a different colour."
"Have you heard of any other type of radiation used in medicine?" asked the doctor. "Do you know how it is used?"



Thermogram

(a) Name the type of radiation given out by the human body.
(b) How does the wavelength of this radiation compare with that of light?
(c) Answer the doctor's last question to Chris by naming another type of radiation used in medicine and state its use.

(SEB 1991)

Ultraviolet

38. Although we cannot see ultraviolet radiation with our eyes, we are sensitive to it. Explain.

39. When some chemicals absorb ultraviolet radiation they glow or emit visible light.

a) What name is given to this effect?
b) Describe how this effect is used in security markings
   (i) at home and
   (ii) in shops.

40. There is ultraviolet radiation present in the radiation from the Sun.

a) What effect does low level exposure have on us?
b) What is a possible effect of over exposure?

41. Ultraviolet radiation can help skin conditions. Describe how doctors can use it to help serious skin conditions.

42. How do sun tan creams work to help protect your skin?

43. Why is it not possible to get a tan indoors, even if sitting at a window?

44. Why do scientists fear more cases of skin cancer if any more of the ozone layer is destroyed?