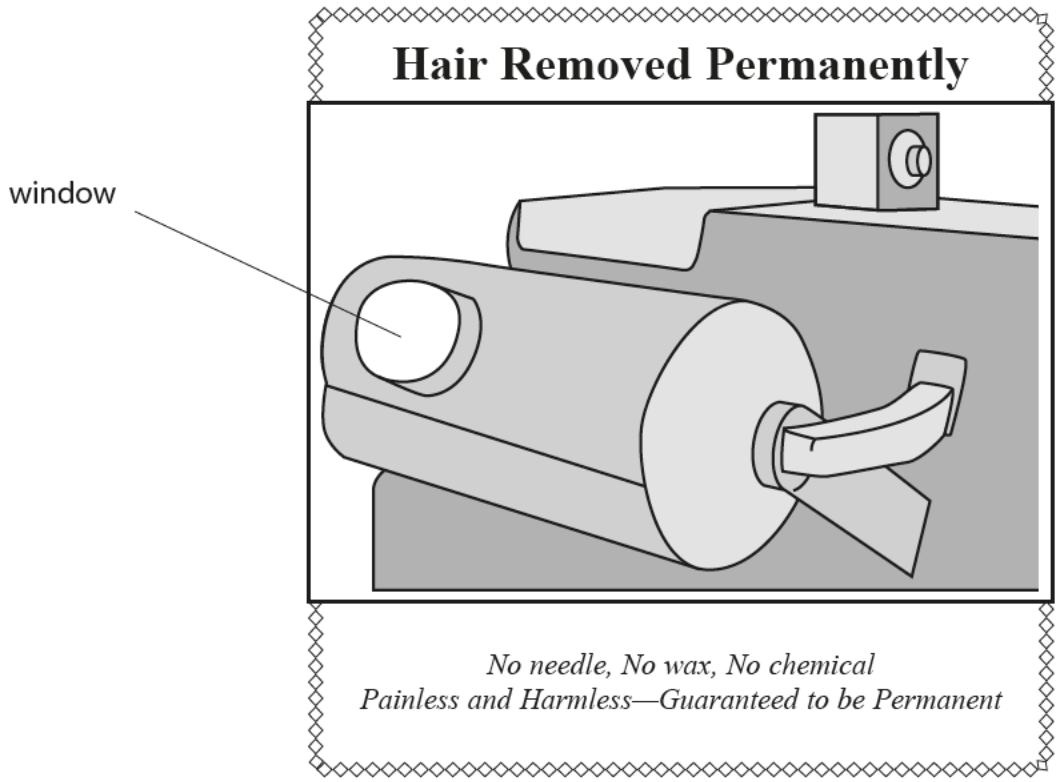
Using X-rays

1 (a) The device shown in the picture was invented not long after the discovery of X-rays.
It emitted X-rays through the window.



In the 1920s, it was used to remove unwanted hair from the arm.
The patient placed her arm in front of the window.
The X-rays destroyed the hair roots.

(i) Complete the sentence by putting a cross (☒) in the box next to your answer.

X-rays are

(1)

☐ **A** electromagnetic waves with very high frequency

☐ **B** electromagnetic waves with very long wavelength

☐ **C** electromagnetic waves which always have low energy

☐ **D** ionising radiations emitted by radioactive sources

(ii) Some users believed that sunglasses would protect their eyes from the X-rays.

Explain how effective this would be as a precaution.

(2)

.....

.....

.....

(iii) This hair removal device was banned in 1940.
Many people who had used it for a long time had become seriously ill.

State **one** of the effects this machine may have had on them.

(1)

.....

.....

(iv) The device was advertised as 'harmless'.

Suggest why people used this device for many years.

(2)

.....

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.....

*(b) There is a hair removal device which is currently available in some specialist clinics. It uses a low energy infrared laser beam. The makers say that this is much less dangerous than the X-ray device.

By considering the dangers associated with both devices, discuss whether the infrared laser device should be put on general sale to the public.

(6)

(Total for Question 5 = 12 marks)

2 Some students repeat Herschel's experiment.

(a) They place four identical thermometers, **P**, **Q**, **R** and **S**, in the shade.

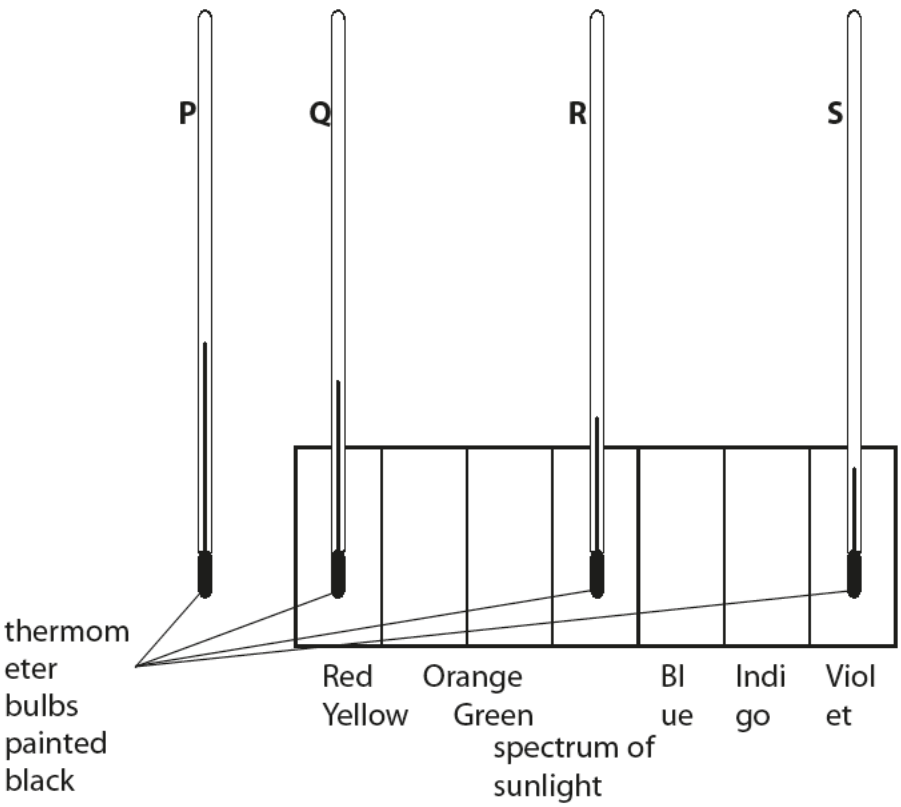
The table shows some of the readings on the thermometers in the shade.

Complete the table to show the reading on thermometer **Q**.

(1)

	thermometers in the shade			
	P	**Q**	**R**	**S**
temperature / °C	18		18	18

(b) Then the four thermometers are placed in the spectrum of sunlight as shown.



(i) The bulbs of the thermometers are painted black.

State why the bulbs of the thermometers are painted black.

(1)

.....

.....

(ii) The table shows the readings on the thermometers in the spectrum of sunlight.

	thermometers in the spectrum of sunlight			
	P	**Q**	**R**	**S**
temperature / °C	25	23	21	20

Describe conclusions that can be made from the students' results.

(2)

.....

.....

.....

.....

(iii) State why the students put the four thermometers together in the shade before placing them in the spectrum of sunlight.

(1)

.....

.....

(c) Another scientist, Ritter, discovered ultraviolet radiation.

(i) Complete the sentence by putting a cross (☒) in the box next to your answer.

Too much exposure to ultraviolet radiation may cause

(1)

☐ **A** deafness

☐ **B** heating of internal body cells

☐ **C** damage to the eyes

☐ **D** damage to the bone cells

(ii) Three signals, ultraviolet, visible light and infrared, are sent from the surface of the Moon to an orbiting spacecraft.

The three signals are sent at the same time.

Which of these is correct for the signals arriving at the spacecraft?

Put a cross (☒) in the box next to your answer.

(1)

☐ **A** the visible light signal arrives first

☐ **B** the ultraviolet signal arrives first

☐ **C** the infrared signal arrives first

☐ **D** all three signals arrive at the same time

(iii) Desc **one** use of ultraviolet radiation.

(2)

.....

.....

.....

.....

(Total for Question 3 = 9 marks)

3 (a) Skin cancer can be caused by radiation from the Sun.

Complete the sentence by putting a cross (☒) in the box next to your answer.

The radiation that causes skin cancer is

(1)

☒ **A** ultraviolet radiation

☒ **B** radio waves

☒ **C** microwaves

☒ **D** infrared radiation

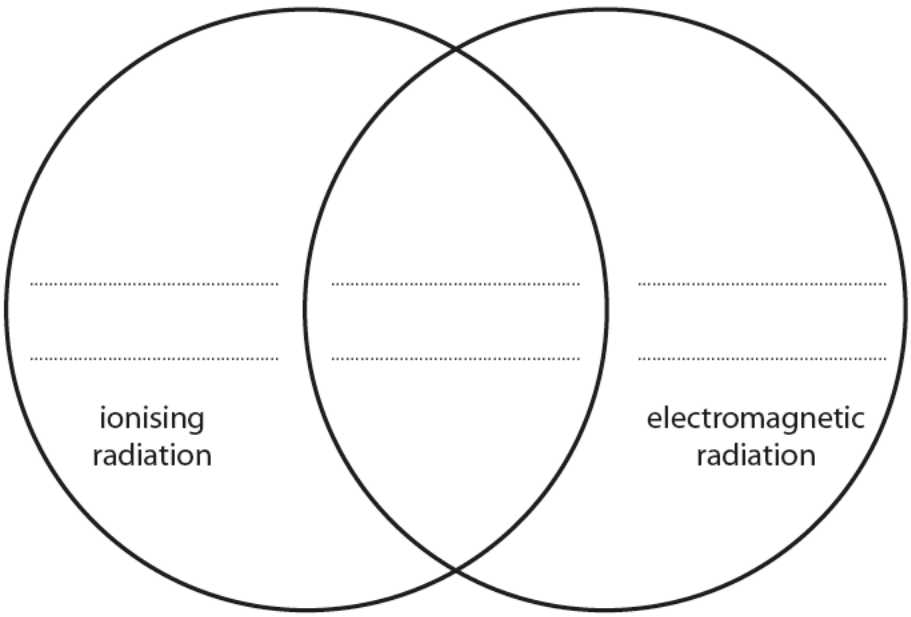
(b) The word box contains the names of three types of radiation.

gamma rays	infrared radiation	particles

Use this diagram to classify the three types of radiation given in the word box.

Write the name of the radiation in the correct section of the diagram.

(2)



(c) Which of these is correct for all electromagnetic waves in a vacuum?

Put a cross (☒) in the box next to your answer.

(1)

☒ **A** they have the same frequency

☒ **B** they have the same wavelength

☒ **C** they are transverse waves

☒ **D** they are longitudinal waves

(d) Describe a use of gamma radiation.

(2)

*(e) Herschel and Ritter carried out experiments that contributed to the discovery of infrared and ultraviolet radiation.

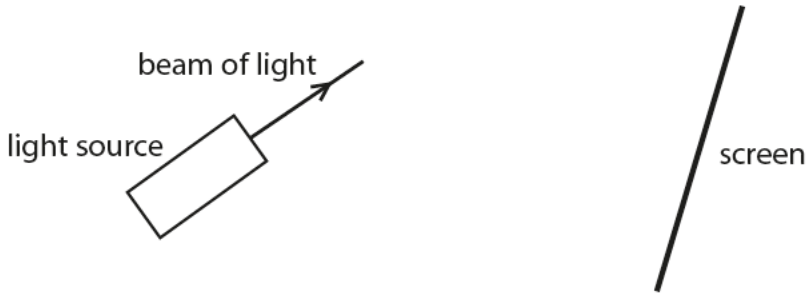
Explain how the results of the experiments carried out by Herschel and Ritter led to these discoveries.

(6)

(Total for Question 5 = 12 marks)

Electromagnetic waves

4 (a) A student investigates the spectrum produced by visible light.
The diagram shows some of the equipment she uses.



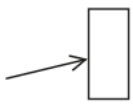
She uses a piece of glass to split up the light into its colours.

(i) Which of the following would be the best shape to use?

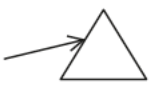
Put a cross (☒) in the box next to your answer.

(1)

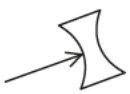
☒ **A**



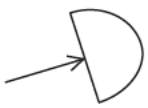
☒ **B**



☒ **C**



☒ **D**



(ii) Each colour has a different wavelength.
List the other colours in order of wavelength.
Three have been done for you.

(2)

Longest wavelength .....

.....

Yellow .....

Green .....

Blue .....

.....

Shortest wavelength .....

(b) Electromagnetic waves have many uses.

Draw **one** straight line from each type of wave to show one use of the wave.

(3)

type of wave	**use of wave**
	checking money
gamma rays	mobile phones
infrared	seeing broken bones
microwaves	sterilising food
	thermal imaging

(c) Both infrared and ultraviolet rays can have harmful effects on our bodies.

Describe how the harmful effects of these rays are different.

(2)

.....

.....

.....

.....

(Total for Question 1 = 8 marks)