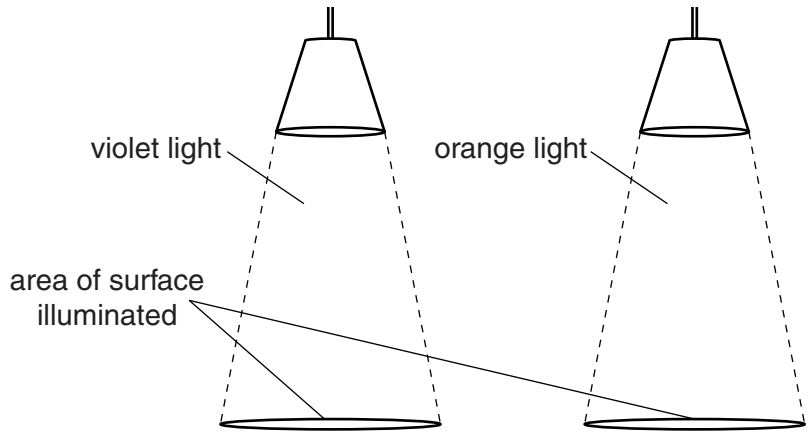
4 **(a)** Some of the statements below are true, and some are false.
Put a tick (✓) in the correct box after each statement.

	true	**false**
High frequency photons have more energy than low frequency photons.	☐	☐
Microwave radiation has the lowest frequency in the electromagnetic spectrum.	☐	☐
Photons are packets of energy.	☐	☐
Red light has higher frequency than violet light.	☐	☐
The intensity of radiation gets larger when you get closer to its source.	☐	☐

[3]

(b) The diagram shows two lamps giving out coloured light.



The energy of photons is measured in units called eV.

The table shows the energy of photons of these two colours of light.

Colour	**Energy in eV**
violet	3
orange	2

Each surface is lit up with the **same intensity** over the same area.

Use information in the table to compare the numbers of photons arriving at each surface each second.
Explain your answer.

.....

.....

..... **[2]**

[Total: 5]

3 Here is a list of some types of waves.

infrared

microwave

sound

ultraviolet

X-ray

(a) Use waves from the list to answer the following questions.

You may use each wave once, more than once or not at all.

(i) Which wave is **not** in the electromagnetic spectrum?

answer ..... **[1]**

(ii) Which wave has photons with the lowest energy?

answer ..... **[1]**

(iii) Which wave has the highest frequency?

answer ..... **[1]**

(iv) Which wave can be used to find metal objects in a suitcase?

answer ..... **[1]**

(v) Which wave is absorbed by the ozone layer in the atmosphere?

answer ..... **[1]**

(b) Which **one** of the following properties is the same for all waves in the electromagnetic spectrum?

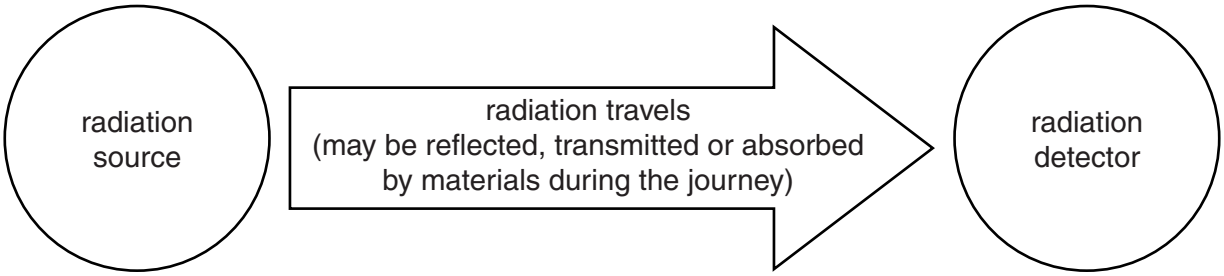
Put a tick (✓) in the box next to the correct property.

colour	☐
intensity	☐
speed in a vacuum	☐
wavelength	☐

[1]

[Total: 6]

4 Scientists use models to help them think about difficult ideas. The diagram shows a general model for radiation.



Prinul lives in the countryside, where there are no street lights.

He thinks this model of radiation works well because it explains why he can see a road sign at night when he uses his car headlights.

Is he correct?

Justify your conclusion carefully.

The quality of written communication will be assessed in your answer.

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... **[6]**

[Total: 6]

5 Use the words from this list to complete the sentences below about a beam of light travelling through space.

photons	**electrons**	**waves**
increases	**decreases**	**stays the same**

The beam of light consists of 'packets' called ..... .

If you increase the frequency of the light, the energy of each 'packet' ..... .

If you increase the frequency of the light, the speed of the light ..... .

[3]

[Total: 3]

6 **(a)** The diagram below shows the electromagnetic spectrum with some parts left blank.
Write **X-rays** in the correct box.

radio waves		infrared		ultraviolet		gamma rays

[1]

(b) Dentists often take an X-ray image of teeth as part of a regular check-up.
Some people worry about the risk to their health from the X-rays.
Explain what the risk is.

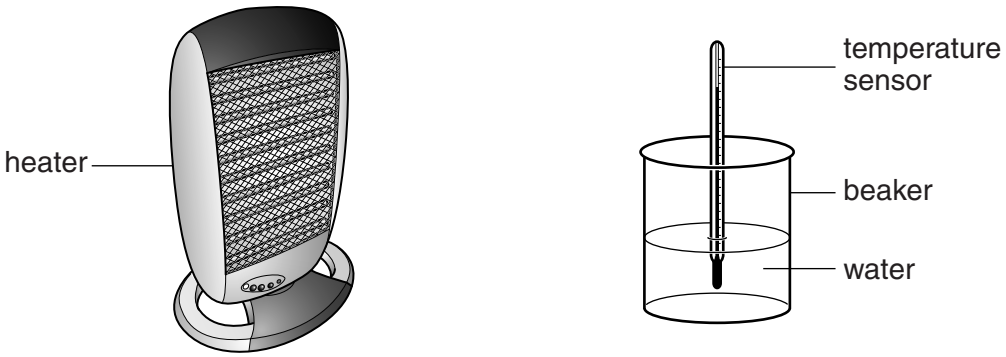
.....

.....

..... **[2]**

[Total: 3]

6 Rachel does an experiment to investigate the heating effect of electromagnetic radiation.



She measures the temperature change of the water in the beaker.

(a) Complete the sentences to explain what is happening to the electromagnetic radiation.

Use words from the list.

absorbed **emitted** **ionised** **transmitted**

The electromagnetic radiation is ..... by the heater.

It is then ..... through the atmosphere and finally .....

by the water. **[3]**

(b) For each of the following changes predict whether the intensity of the radiation reaching the water will increase, decrease or stay the same.

Put one tick (✓) in each row.

	Intensity		
	Decrease	**Stay the same**	**Increase**
use lower energy photons			
use higher frequency radiation			
use a smaller distance between heater and water			
use more water			

[3]

[Total: 6]