

Name:

Date:

P6 - Test 5
Waves
Advanced

GCSE

PHYSICS

AQA - Triple Science

Mark

Grade

Materials

For this paper you must have:

- Ruler
- Pencil and Rubber
- Scientific calculator, which you are expected to use when appropriate

Instructions

- Answer all questions
- Answer questions in the space provided
- All working must be shown

Information

- The marks for the questions are shown in brackets

1.

Different parts of the electromagnetic spectrum have different uses.

(a) The diagram shows the electromagnetic spectrum.

Radio waves	Microwaves	Infrared	Visible light	Ultraviolet	X-rays	Gamma rays
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(i) Use the correct answers from the box to complete the sentence.

amplitude	frequency	speed	wavelength
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The arrow in the diagram is in the direction of increasing _____ and decreasing _____ .

(2)

(ii) Draw a ring around the correct answer to complete the sentence.

The range of wavelengths for waves in the electromagnetic

spectrum is approximately

10^{-15} to 10^4
10^{-4} to 10^4
10^4 to 10^{15}

metres.

(1)

(b) The wavelength of a radio wave is 1500 m.
The speed of radio waves is 3.0×10^8 m / s.

Calculate the frequency of the radio wave.

Give the unit.

Frequency = _____

(3)

(c) (i) State **one** hazard of exposure to infrared radiation.

(1)

(ii) State **one** hazard of exposure to ultraviolet radiation.

(1)

(d) X-rays are used in hospitals for computed tomography (CT) scans.

(i) State **one** other medical use for X-rays.

(1)

(ii) State a property of X-rays that makes them suitable for your answer in part **(d)(i)**.

(1)

(iii) The scientific unit of measurement used to measure the dose received from radiations, such as X-rays or background radiation, is the millisievert (mSv).

The table shows the X-ray dose resulting from CT scans of various parts of the body.

The table also shows the time it would take to get the same dose from background radiation.

Part of the body	X-ray dose in mSv	Time it would take to get the same dose from background radiation
Abdomen	9.0	3 years
Sinuses	0.5	2 months
Spine	4.0	16 months

A student suggests that the X-ray dose and the time it would take to get the same dose from background radiation are directly proportional.

Use calculations to test this suggestion and state your conclusion.

(3)

(Total 13 marks)

2.

The picture shows a pre-natal scan obtained using ultrasonic waves.



(i) Explain how ultrasonic waves are used to produce the image of an unborn baby.

(2)

(ii) Give another use for ultrasonic waves.

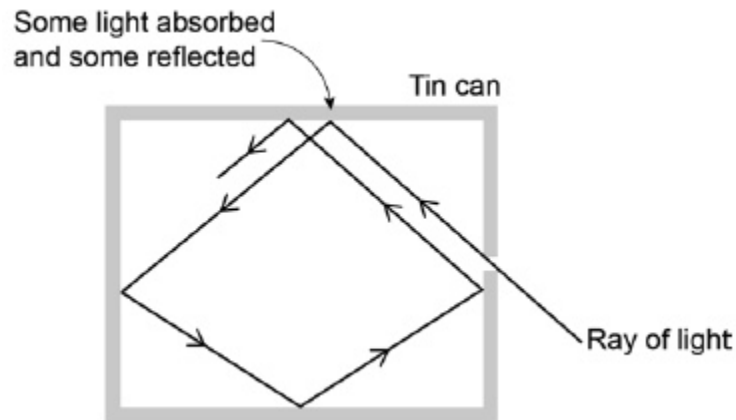
(1)

(Total 3 marks)

3.

Figure 1 shows what happens when a ray of light enters a tin can through a small hole.

Figure 1



(a) Explain why the small hole looks black.

(2)

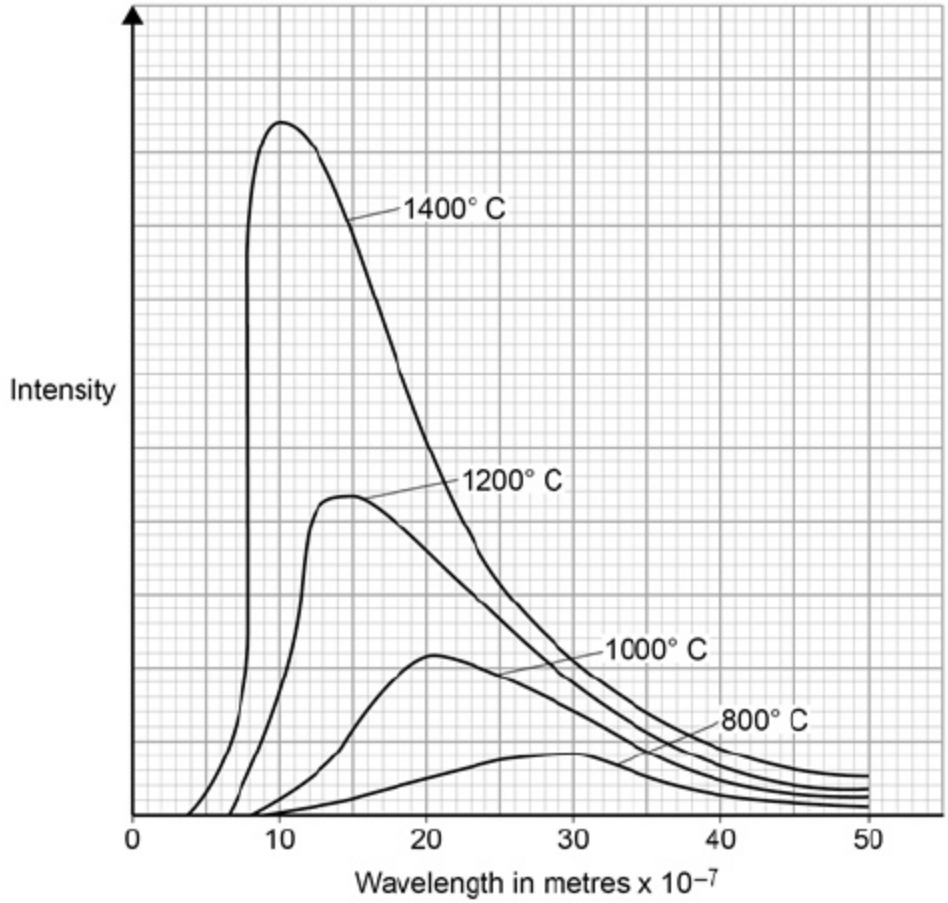
(b) All objects absorb and emit radiation.

What is meant when an object is described as a perfect black body?

(1)

Figure 2 shows how the intensity of different wavelengths of radiation from a hot object varies with temperature.

Figure 2



(c) What can be concluded from **Figure 2** about how the distribution of the intensity of radiation from an object changes as the temperature of the object increases?

(3)

- (d) The wavelength at which the Sun emits the maximum intensity of radiation is approximately $5 \times 10^{-7} \text{ m}$

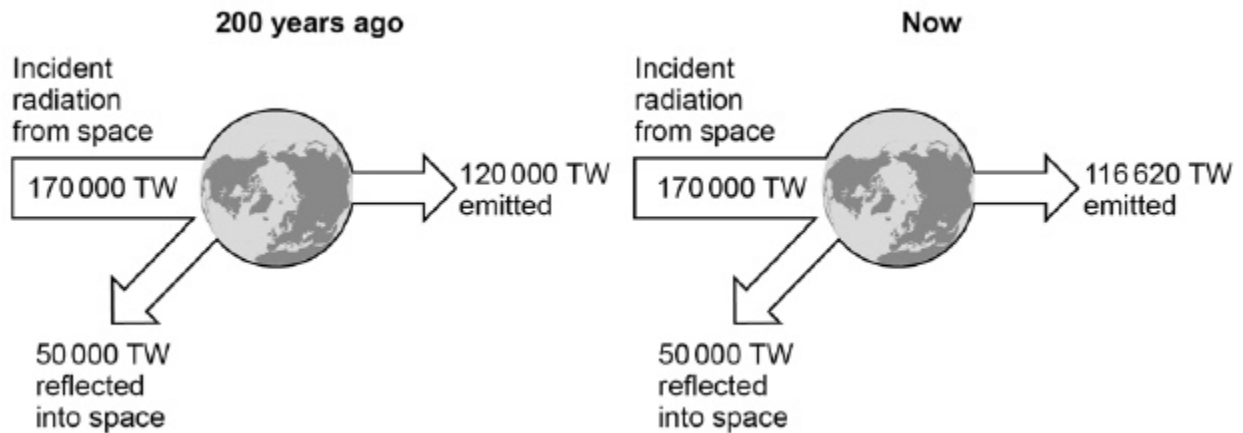
Estimate the surface temperature of the Sun.

Use **Figure 2**.

(1)

- (e) **Figure 3** shows how the balance between the incident radiation from space and the radiation emitted by the Earth into space has changed over the last 200 years.

Figure 3



Explain how the temperature of the Earth and its atmosphere has changed over the last 200 years.

Use the information in **Figure 3**.

(3)

(Total 10 marks)

4.

(a) The wavelengths of four different types of electromagnetic wave, including visible light waves, are given in the table.

Type of wave	Wavelength
Visible light	0.0005 mm
A	1.1 km
B	100 mm
C	0.18 mm

Which of the waves, **A**, **B** or **C**, is an infra red wave? _____

(1)

(b) A TV station broadcasts at 500 000 kHz. The waves travel through the air at 300 000 000 m/s.

Calculate the wavelength of the waves broadcast by this station.

Show clearly how you work out your answer.

Wavelength = _____ m

(2)

(c) What happens when a metal aerial absorbs radio waves?

(2)

(d) Stars emit all types of electromagnetic waves. Telescopes that monitor X-rays are mounted on satellites in space.

Why would an X-ray telescope based on Earth not be able to detect X-rays emitted from distant stars?

(1)

(Total 6 marks)

5.

(a) Microwaves are one type of electromagnetic wave.

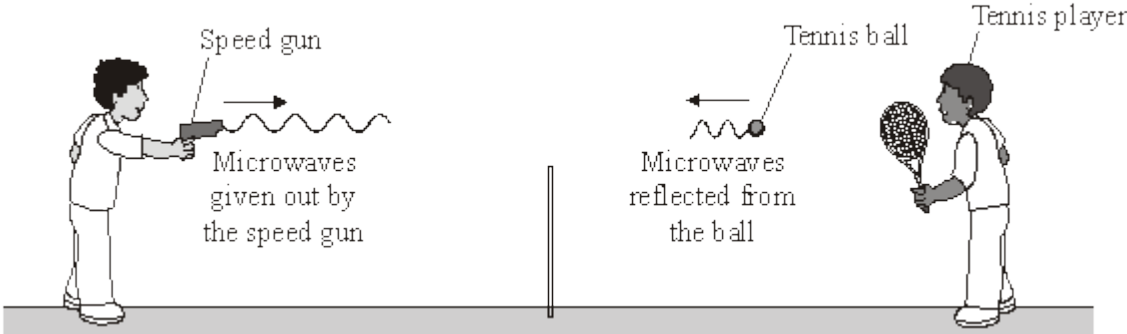
(i) Which type of electromagnetic wave has a lower frequency than microwaves?

(1)

(ii) What do all types of electromagnetic wave transfer from one place to another?

(1)

(b) The picture shows a tennis coach using a speed gun to measure how fast the player serves the ball.



(i) The microwaves transmitted by the speed gun have a frequency of 24 000 000 000 Hz and travel through the air at 300 000 000 m/s.

Calculate the wavelength of the microwaves emitted from the speed gun.

Show clearly how you work out your answer.

Wavelength = _____ m

(2)

(ii) Some of the microwaves transmitted by the speed gun are absorbed by the ball.

What effect will the absorbed microwaves have on the ball?

(1)

(Total 5 marks)

6.

(a) Microwaves and visible light are two types of electromagnetic wave. Both can be used for communications.

(i) Give **two** properties that are common to both visible light and microwaves.

1. _____

2. _____

(2)

(ii) Name **two** more types of electromagnetic wave that can be used for communications.

_____ and _____

(1)

(b) Wi-Fi is a system that joins computers to the internet without using wires. Microwaves, with a wavelength of 12.5 cm, are used to link a computer to a device called a router. Microwaves travel through the air at 300 000 000 m/s.

Calculate the frequency of the microwaves used to link the computer to the router.

Show clearly how you work out your answer and give the unit.

Frequency = _____

(3)

(c) Wi-Fi is used widely in schools. However, not everyone thinks that this is a good idea.

A politician commented on the increasing use of Wi-Fi. He said: 'I believe that these systems may be harmful to children.'

However, one group of scientists said that there is no reason why Wi-Fi should not be used in schools. These scientists also suggested that there is a need for further research.

(i) Suggest what the politician could have done to persuade people that what he said was not just an opinion.

(1)

(ii) Why did the group of scientists suggest that there is a need for further research?

(1)

(Total 8 marks)

7.

Radio waves and microwaves are two types of electromagnetic wave.

Both waves:

- can be used for communications
- travel at the same speed through air.

(a) Give **two** more properties that are the same for both radio waves and microwaves.

1. _____

2. _____

(2)

(b) Some satellites are used to transmit television programmes. Signals are sent to, and transmitted from, the satellites using microwaves.

What is the property of microwaves that allows them to be used for satellite communications?

(1)

(c) Electromagnetic waves travel at a speed of 3.0×10^8 m/s.

A radio station transmits waves with a wavelength of 2.5×10^2 m.

Calculate the frequency of the radio waves.

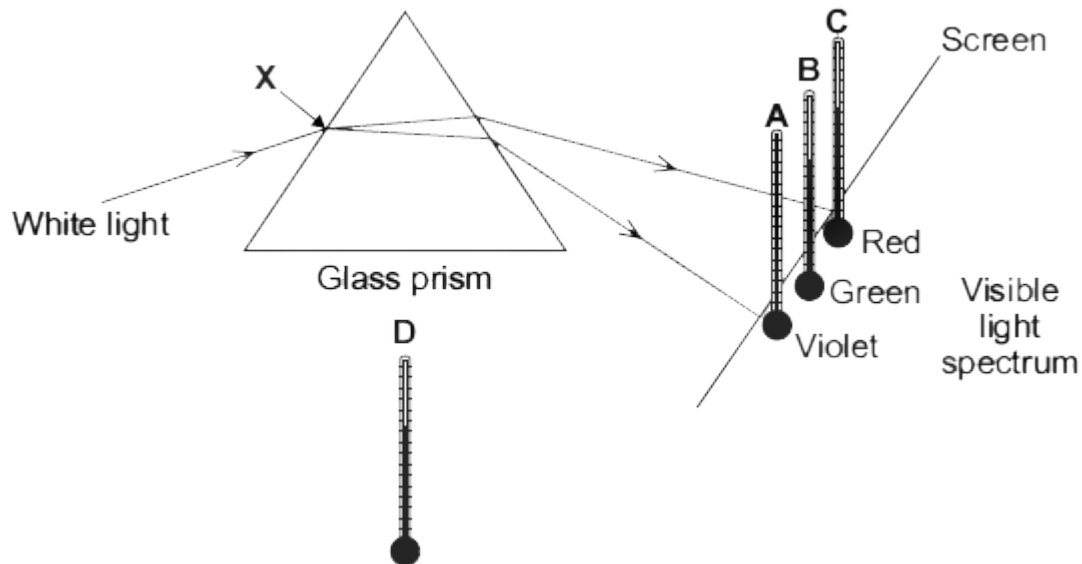
Show clearly how you work out your answer and give the unit.

Frequency = _____

(3)

(Total 6 marks)

8. The diagram shows the apparatus that a student used to investigate the heating effect of different wavelengths of light.



(a) (i) The student put thermometer **D** outside of the light spectrum.

Suggest why.

(1)

- (ii) The table gives the position and reading of each thermometer 10 minutes after the investigation started.

Thermometer	Position of thermometer	Temperature in °C
A	in violet light	21
B	in green light	22
C	in red light	24
D	outside the spectrum	20

What should the student conclude from the data in the table?

(2)

- (b) A similar investigation completed in 1800 by the scientist Sir William Herschel led to the discovery of infrared radiation.

Suggest how the student could show that the spectrum produced by the glass prism has an infrared region.

(2)

(c) A person emits infrared radiation at a frequency of 3.2×10^{13} Hz.

Calculate the wavelength of the infrared radiation that a person emits.

Take the speed of infrared radiation to be 3.0×10^8 m/s.

Show clearly how you work out your answer.

Wavelength = _____ m

(2)

(d) A thermal imaging camera detects infrared radiation. Electronic circuits inside the camera produce a visible image of the object emitting the infrared radiation.

At night, police officers use thermal imaging cameras to track criminals running away from crime scenes.

Thermal imaging cameras work better at night than during the day.

Explain why.

(2)

(Total 9 marks)

9.

(a) The wavelengths of four different types of electromagnetic wave, including visible light waves, are given in the table.

Type of wave	Wavelength
Visible light	0.0005 mm
A	1.1 km
B	100 mm
C	0.18 mm

Which of the waves, **A**, **B**, or **C**, is an infra red wave?

(1)

(b) A TV station broadcasts at 500 000 kHz. The waves travel through the air at 300 000 000 m/s.

Calculate the wavelength of the waves broadcast by this station.

Show clearly how you work out your answer.

Wavelength = _____ m

(2)

(c) What happens when a metal aerial absorbs radio waves?

(2)

- (d) Stars emit all types of electromagnetic waves. Telescopes that monitor X-rays are mounted on satellites in space.

Why would an X-ray telescope based on Earth **not** be able to detect X-rays emitted from distant stars?

(1)

(Total 6 marks)

10.

- (a) The diagram shows a lens used as a magnifying glass. The position of the eye is shown and the size and position of an object standing at point **O**.

- (i) What type of lens is shown in the diagram?

(1)

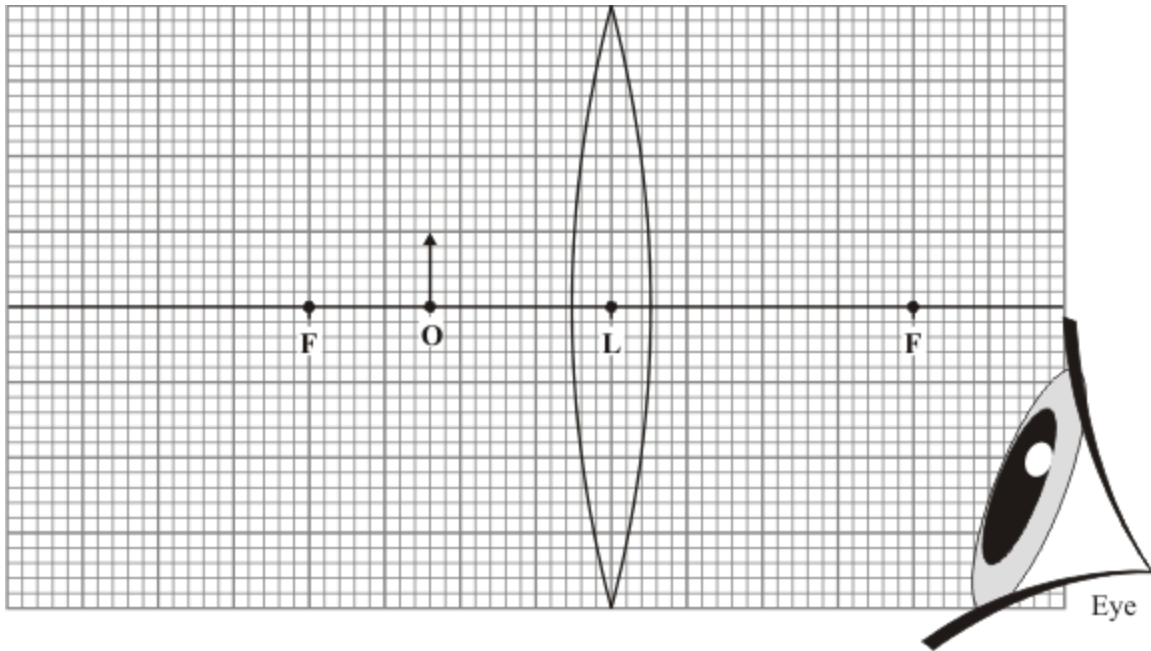
- (ii) Two points are marked as **F**. What are these points?

(1)

- (iii) What is the name of the straight line which goes through the point **F**, through the point **L** at the centre of the lens, and through the point **F** on the other side?

(1)

- (iv) On the diagram, use a ruler to construct accurately the position of the image. You should show how you construct your ray diagram and how light appears to come from this image to enter the eye.



(5)

- (v) The image is *virtual*. What is a *virtual* image?

(1)

- (b) The lens shown in the diagram in part (a)(iv) can be used in a camera to produce a *real* image.

Explain why a *real* image must be produced in a camera and how the object and the lens are positioned to produce a *real* image which is **smaller** than the object.

Do **not** draw a ray diagram as part of your answer.

(3)

(Total 12 marks)