2021 ASSESSMENT MATERIALS

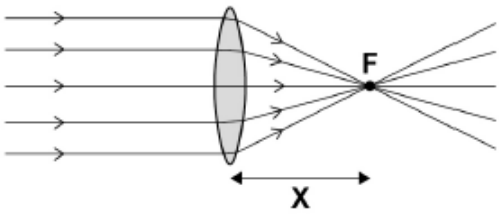
# GCSE
# PHYSICS

## Physics Test 5: Waves (Higher)

Total number of marks: 37

**0 8 . 1** **Figure 20** shows parallel rays of light being refracted by a convex lens.

**Figure 20**




What is distance '**X**' called?

**[1 mark]**

Focal Length

**0 8 . 2** Lenses can be used to form the image of an object.

Complete the ray diagram in **Figure 21** to show how a **convex** lens forms the image of the object.

Use an arrow to represent the image.

**[2 marks]**

**Figure 21**

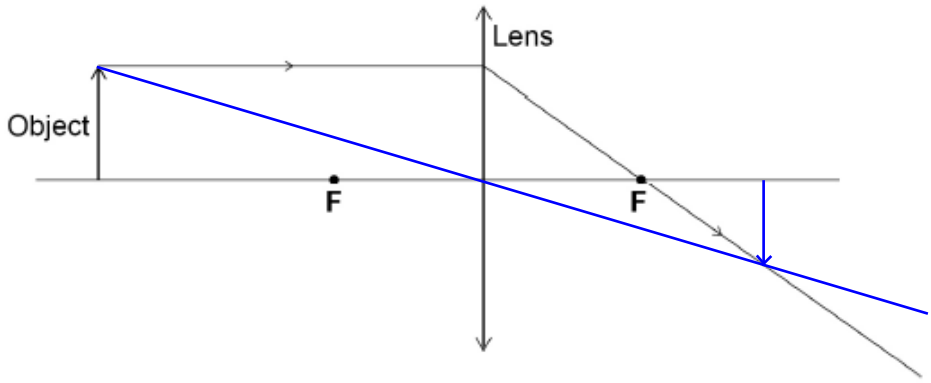
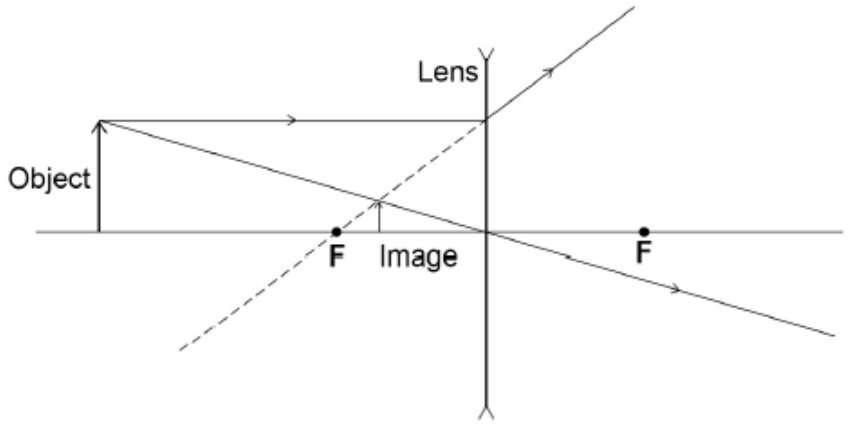


**Figure 22** shows how a **concave** lens forms the image of an object.

**Figure 22**




**0 8 . 3** Give **one** similarity and **one** difference between the image formed by the convex lens and the image formed by the concave lens.

**[2 marks]**

Similarity Image is diminished.

Difference Image formed is inverted in the the convex lens while image is upright in concave lens.

**0 8 . 4** A person uses a lens to read the letters on the back of a coin.

The image height of the letters on the coin is 9.0 mm

The magnification produced by the lens is 6.0

Calculate the height of the letters on the coin.

Use the Physics Equations sheet.

**[3 marks]**

$\frac{\text{Image height}}{\text{Object height}} = 6$

$\frac{9}{6} = \text{object height}$

Height = 1.5 mm

**0 5** **Figure 7** shows the apparatus a student used to investigate the reflection of light by a plane mirror.

The student drew four ray diagrams for each angle of incidence.

The student measured the angle of reflection from each diagram.

**Table 2** gives the student's results.

**Figure 7**

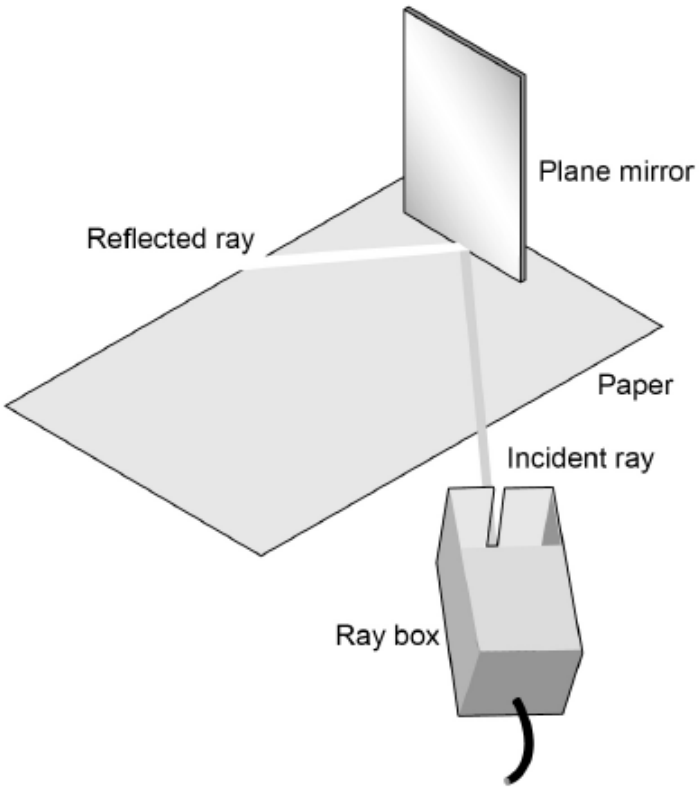



**Table 2**

| | Angle of reflection | | | |
|---|---|---|---|---|
| **Angle of incidence** | **Test 1** | **Test 2** | **Test 3** | **Test 4** |
| 20° | 19° | 22° | 20° | 19° |
| 30° | 31° | 28° | 32° | 30° |
| 40° | 42° | 40° | 43° | 41° |
| 50° | 56° | 49° | 53° | 46° |

**0 5 . 1** For each angle of incidence, the angle of reflection has a range of values.

This is caused by an error.

What type of error will have caused each angle of reflection to have a range of values?

**[1 mark]**

Random Error

**0 5 . 2** Suggest what the student may have done during the investigation to cause each angle of reflection to have a range of values.

**[1 mark]**

The student may have accidently moved the position of the plane mirror or ray box.

**0 5 . 3** Estimate the uncertainty in the angle of reflection when the angle of incidence is 50°.

Show how you determine your estimate.

**[2 marks]**

$\frac{56 - 46}{2} = \frac{10}{2}$

Uncertainty = $\pm$ 5 °

**0 5 . 4** The student concluded that for a plane mirror, the angle of incidence is equal to the angle of reflection.

Explain whether you agree with this conclusion.

Use examples from the results in **Table 2** in your answer.

**[2 marks]**

I agree as the mean of the values of angle of reflection for each experiment is approximately equal to the angle of incidence.
Eg: When the angle of incidence was 20, the mean of all four readings of the angle of reflection was 20.

**0 5 . 5** What extra evidence could be collected to support the student's conclusion?

**[1 mark]**

Repeat the experiment over a larger range of incident angles.

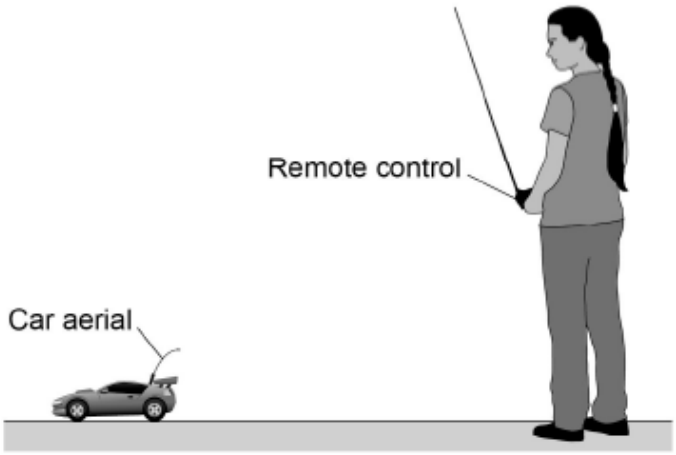
**0 5 . 6** State **one** change the student should make to the apparatus if he wants to use the same method to investigate diffuse reflection.

**[1 mark]**

Use a rough reflecting surface instead of the mirror.

**0 6** **Figure 8** shows a student playing with a remote-controlled car.

**Figure 8**




**0 6 . 1** The remote control transmits radio waves to the car aerial.

The transmitted radio waves have a frequency of 320 MHz.

speed of radio waves = $3.0 \times 10^8$ m/s

Calculate the wavelength of the radio waves.

Give the unit. $v = f\lambda$

$3 \times 10^8 = 320 \times 10^6 \times \lambda$

**[5 marks]**

Wavelength = 0.938 Unit m

**0 6 . 2** The car aerial is connected to an electrical circuit in the car.

Describe what happens in the electrical circuit when the car aerial absorbs radio waves.

**[2 marks]**

It creates an alternating current with the same frequency as the wave and the information transmitted is decoded.

**0 6 . 3** The car produces sound waves.

Give **two** ways in which radio waves are different to sound waves.

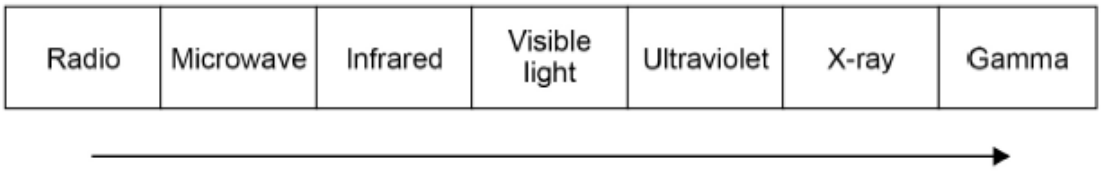
**[2 marks]**

1 Radio waves can travel through a vacuum.

2 Particles of the radio wave oscillate perpendicular to the direction which the wave travels.

**0 7 . 1** **Figure 12** shows the electromagnetic spectrum.

**Figure 12**




Which statement is correct for the direction of the arrow in **Figure 12**?

**[1 mark]**

Tick (✓) **one** box.

- The wavelength decreases and the wave speed in air increases. ☐
- The frequency increases and the wavelength increases. ☐
- The frequency increases and the wave speed in air stays the same. ☑
- The wavelength increases and the wave speed in air increases. ☐

**0 7 . 2** Explain how the properties of X-rays make them suitable for the medical imaging of bones.

**[2 marks]**

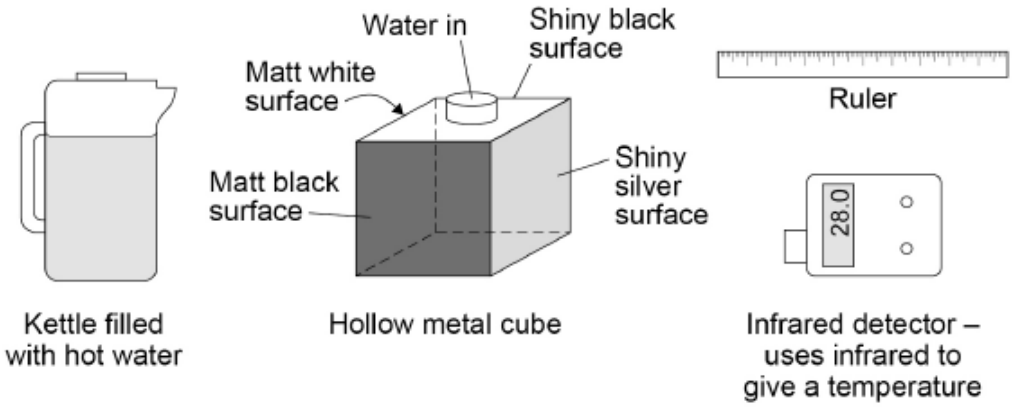
The high energy of the wave allows it to be easily transmitted through tissues with little absorption. X-rays are also easily absorbed by bones to help to see defects in bones by differentiating the bone from the flesh..

A student investigated the infrared radiation emitted from the sides of a hollow metal cube.

The sides of the cube are different colours or textures.

**Figure 13** shows the equipment used.

**Figure 13**




Boiling water was poured into the cube. The amount of infrared radiation emitted from each vertical surface was then measured.

**0 7 . 3** Boiling water is a hazard in this investigation.

Suggest how the risk of harm could be reduced in this investigation.

**[1 mark]**

Wear protective glasses and wear gloves.

**0 7 . 4** What is the control variable in this investigation?

**[1 mark]**

Initial temperature of the water

**Table 2** shows the results.

**Table 2**

| Type of surface | Temperature in °C |
|---|---|
| Matt black | 68.0 |
| Matt white | 65.5 |
| Shiny black | 66.3 |
| Shiny silver | 28.0 |

**0 7 . 5** The four temperature values in **Table 2** cannot be used to show that the infrared detector gives precise readings.

Give the reason why.

**[1 mark]**

Only one reading for each surface is taken.

**0 7 . 6** The student looked at the data in **Table 2** and concluded:

'A black surface always emits more infrared radiation than a white surface.'

Explain how using an infrared detector with a resolution of 1 °C would have affected the student's conclusion.

**[2 marks]**

In that scenario, Matt white and Shiny black would both have a temperature reading of 66°C which clashes with the conclusion as both surfaces are seen to emit the same radiation.

Albedo is a measure of the amount of solar radiation reflected by an object compared to the total solar radiation incident on the object.

A perfect reflector has an Albedo value of 1.0
A perfect absorber has an Albedo value of 0.0

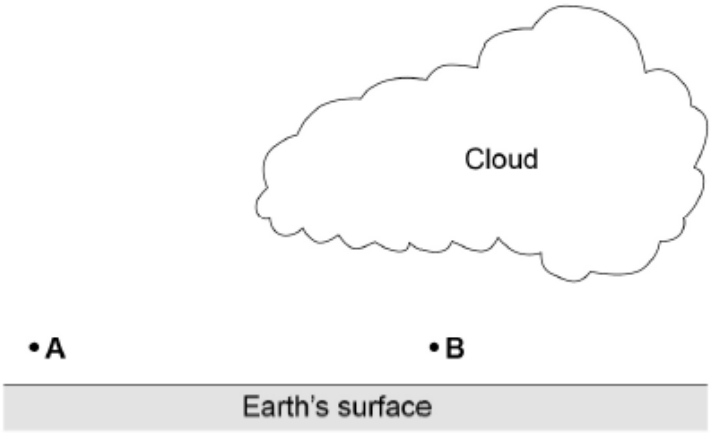
**0 7 . 7** What is the Albedo value of a perfect black body?

**[1 mark]**

0.0 as all radiation will be absorbed

0 7 . 8 **Figure 14** shows two points, **A** and **B**, just above the Earth's surface.

**Figure 14**




The average Albedo value of the Earth's surface is 0.3
The Albedo value of thick cloud varies between 0.6 and 0.9

At night the air at point **A** cools faster than the air at point **B**.

Explain why.

**[3 marks]**

The radiation experienced at A is higher as it receives solar radiation directly. However, in B some of the radiation is absorbed by the cloud and the area receives less radiation. As the starting temperature of the surface at A is high, the rate of cooling also increases.