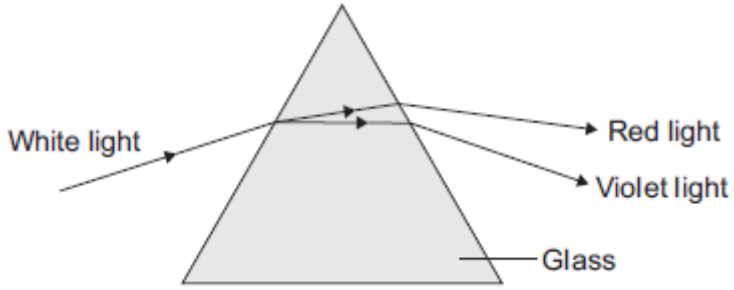
Name _____

Q9. Visible white light consists of several different colours.

Figure 1 shows white light passing through a triangular glass prism.

The white light splits up into different colours. Two of the colours are shown.

Figure 1



(a) (i) Use the correct answer from the box to complete the sentence.

deflection	**diffraction**	**dispersion**

The process in which white light is split up into different colours

is called ..... .

(1)

(ii) Visible light is part of the electromagnetic spectrum.

Figure 2 shows part of the electromagnetic spectrum.

Figure 2

Infrared	Visible	Ultraviolet

Three of the colours of visible light are **green**, **red** and **violet**.

Place these colours in order of increasing wavelength.

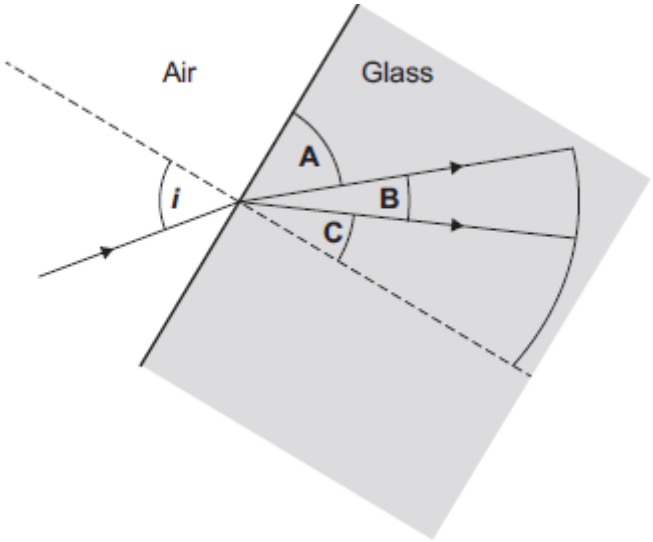
....
Smallest wavelength Largest wavelength

(1)

(b) **Figure 3** shows white light being refracted at the first surface of the triangular glass prism.

The two refracted rays shown are for red light and violet light.

Figure 3



The angle of incidence is labelled ***i***. The other angles are labelled **A**, **B** and **C**.

(i) What is the name given to the dashed line?

.....

(1)

(ii) Which angle, **A**, **B** or **C**, is the angle of refraction for violet light?

Write the correct answer in the box. ☐

(1)

(iii) The refractive index of a particular glass is different for different colours of light.

Explain why.

.....

.....

.....

.....

.....

.....

(3)

(c) The table below shows the refractive index values of a particular glass for different colours of light.

Colour	**Refractive index**
Red	1.509
Green	1.515
Violet	1.521

(i) Using the information in the table, state how the refractive index of the glass varies with the wavelength of the light.

.....

.....

(1)

(ii) Use the data in the table to calculate the speed of green light in the glass.

$$\text{refractive index} = \frac{\text{speed of light in a vacuum}}{\text{speed of light in glass}}$$

Speed of green light in a vacuum = 3.00×10^8 m / s.

.....

.....

.....

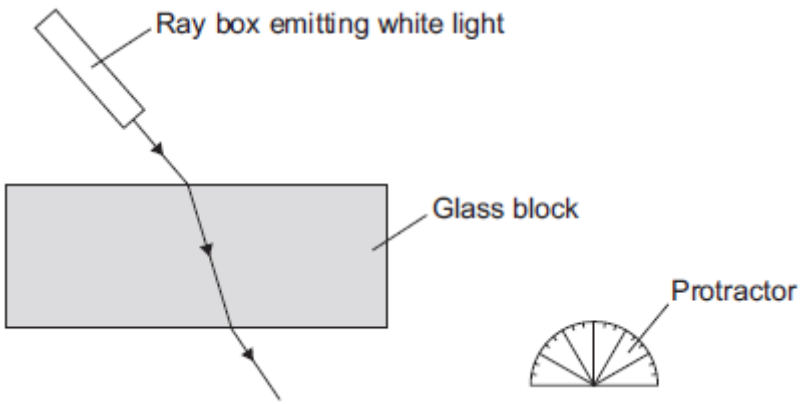
.....

Speed of green light in the glass = ... m / s

(2)

(d) **Figure 4** shows apparatus that can be used to find the refractive index for glass.

Figure 4



This apparatus **cannot** be used to get the results shown in the table.

Give **two** reasons why.

1 .....

.....

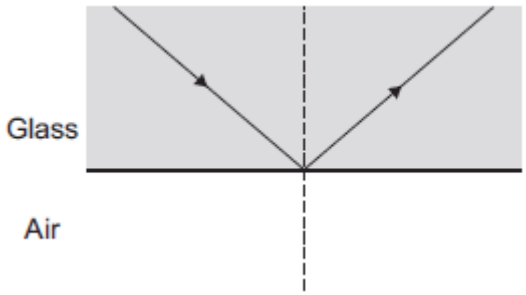
2 .....

.....

(2)

(e) **Figure 5** shows violet light within a glass block.

Figure 5



(i) Describe and explain what happens to the violet light as it meets the boundary between glass and air.

.....

.....

.....

.....

.....

.....

(4)

(ii) Use data from the table above to calculate the critical angle for violet light in glass.

Use the correct equation from **Section B** of the Physics Equations Sheet.

.....

.....

.....

Critical angle = ... degrees

(3)

(Total 19 marks)

Q10.(a) Electromagnetic waves form a continuous spectrum with a range of wavelengths.

What is the approximate range of wavelengths of electromagnetic waves?

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

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

10^{-6} metres to 10^{6} metres

(1)

(b) Infrared waves and microwaves are used for communications.

(i) Give **one** example of infrared waves being used for communication.

.....

.....

(1)

(ii) A mobile phone network uses microwaves to transmit signals through the air. The microwaves have a frequency of 1.8×10^{9} Hz and travel at a speed of 3.0×10^{8} m/s.

Calculate the wavelength of the microwaves.

Give your answer to **two** significant figures.

.....

.....

Wavelength = ... m

(3)

(c) Some scientists suggest there is a possible link between using a mobile phone and male fertility.

The results of their study are given in the table.

Mobile phone use in hours per day	**Sperm count in millions of sperm cells per cm^3 of semen**
0	86
less than 2	69
2 – 4	59
more than 4	50

The results show a negative correlation: the more hours a mobile phone is used each day, the lower the sperm count. However, the results do **not** necessarily mean using a mobile phone causes the reduced sperm count.

Suggest **one** reason why.

.....

(1)

(Total 6 marks)

Q11.Figure 1 shows how a ray of light from a laser travels along an optical fibre.

Figure 1

(a) Why does the ray of light stay within the optical fibre?

.....

.....

(1)

(b) The material used to make the optical fibre has a refractive index of 1.50.

Calculate the critical angle of this material.

.....

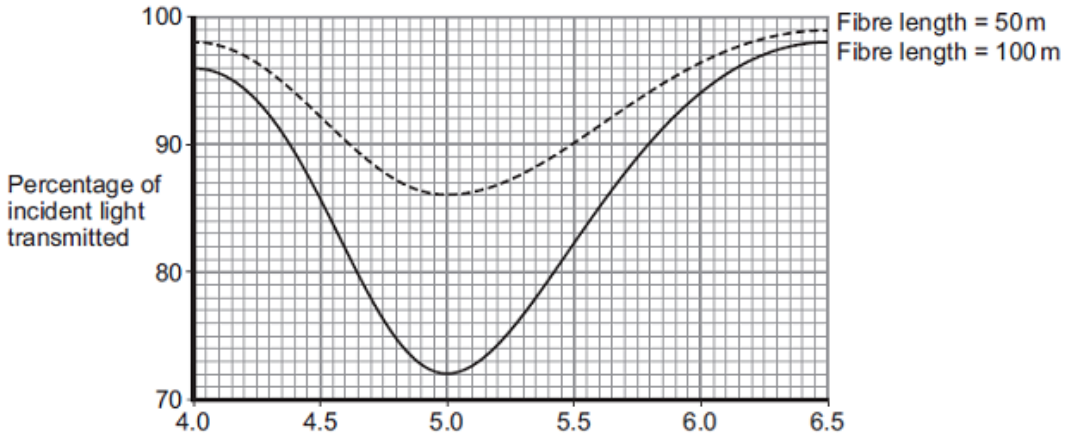
.....

Critical angle = ... degrees

(2)

(c) Different wavelengths of light can be used to transmit information along optical fibres.

Figure 2 shows how the percentage of incident light transmitted through a fibre varies with the wavelength of light and the length of the fibre.



Compare the percentages of incident light transmitted through the two different fibres over the range of wavelengths shown.

.....

.....

.....

.....

(3)

(Total 6 marks)

Q12.(a) Human ears can detect a range of sound frequencies.

(i) Use the correct answers from the box to complete the sentence.

2	**20**	**200**	**2000**	**20 000**

The range of human hearing is from about ..... Hz to ..... Hz.

(2)

(ii) What is ultrasound?

.....

.....

(1)

(iii) Ultrasound can be used to find the speed of blood flow in an artery.

State **one** other medical use of ultrasound.

.....

(1)

(b) The speed of an ultrasound wave in soft tissue in the human body is 1.5×10^3 m / s and the frequency of the wave is 2.0×10^6 Hz.

Calculate the wavelength of the ultrasound wave.

Use the correct equation from **Section B** of the Physics Equations Sheet.

.....

.....

Wavelength = ... m

(2)

(c) When ultrasound is used to find the speed of blood flow in an artery:

- an ultrasound transducer is placed on a person's arm
- ultrasound is emitted by the transducer
- the ultrasound is reflected from blood cells moving **away** from the transducer
- the reflected ultrasound is detected at the transducer.

Describe the differences between the ultrasound waves emitted by the transducer and the reflected waves detected at the transducer.

.....

.....

.....

(2)

(Total 8 marks)

Q13. Galaxies emit all types of electromagnetic wave.

(a) (i) Which type of electromagnetic wave has the shortest wavelength?

.....

(1)

(ii) State **one** difference between an ultraviolet wave and a visible light wave.

.....

.....

(1)

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

The radio waves emitted from a distant galaxy have a wavelength of 25 metres.

Calculate the frequency of the radio waves emitted from the galaxy and give the unit.

.....

.....

.....

Frequency = ...

(3)

(c) Scientists use a radio telescope to measure the wavelength of the radio waves emitted from the galaxy in part (b) as the waves reach the Earth. The scientists measure the wavelength as 25.2 metres. The effect causing this observed increase in wavelength is called red-shift.

(i) The waves emitted from most galaxies show red-shift.What does red-shift tell scientists about the direction most galaxies are moving?

.....

.....

(1)

(ii) The size of the red-shift is **not** the same for all galaxies.

What information can scientists find out about a galaxy when they measure the size of the red-shift the galaxy produces?

.....

.....

.....

(2)

(iii) What does the observation of red-shift suggest is happening to the Universe?

.....

.....

(1)

(Total 9 marks)