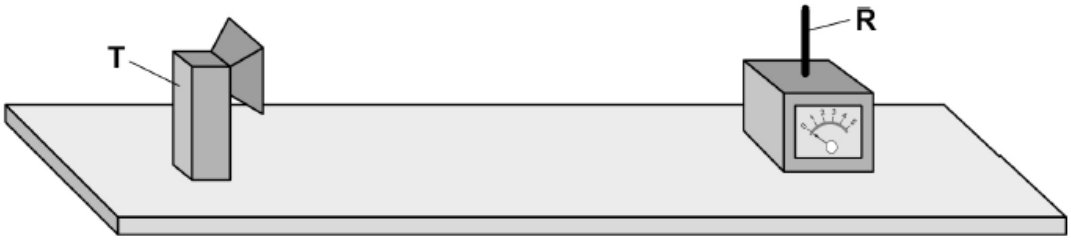
Waves – A2 Physics P1

1. No. 02

0 2 **Figure 1** shows apparatus used to investigate the properties of microwaves.
The microwaves from the transmitter **T** are vertically polarised and have a wavelength of about 3 cm.
The microwaves are detected at the receiver by a vertical metal rod **R**.

Figure 1



0 2 . 1 Explain how the apparatus can be used to demonstrate that the waves from **T** are vertically polarised.

[3 marks]

Figures 2a and **2b** show **T** and **R** and two different positions of a metal plate **M** that reflects microwaves. **M** is vertical and parallel to the direct transmission from **T** to **R**.

Figure 2a

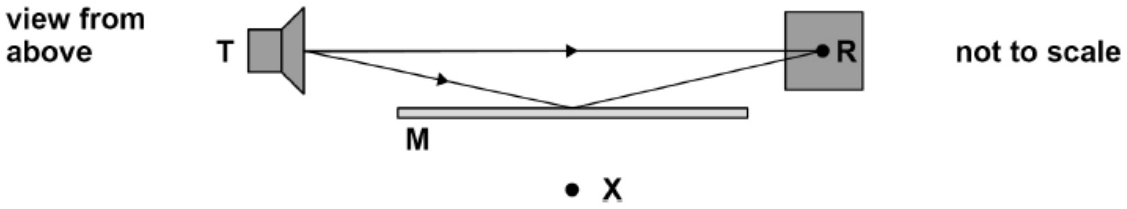
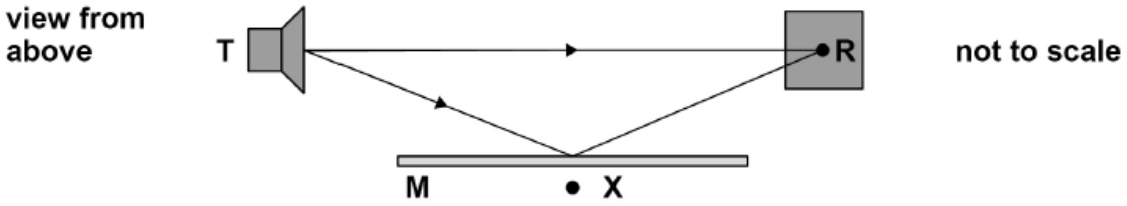


Figure 2b



In an experiment, **T** and **R** are about two metres apart. **M** is moved slowly towards **X**.
Figure 2a shows the initial position of **M**.
Figure 2b shows **M** when it has been moved a few centimetres.

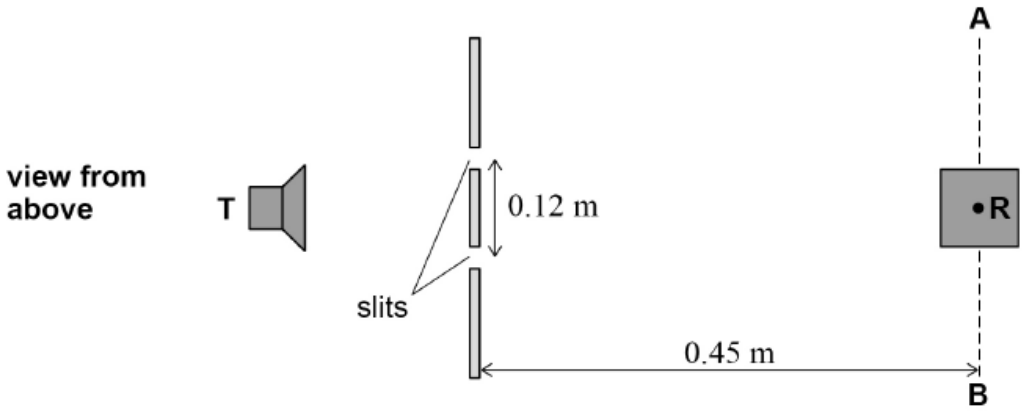
The arrowed lines show the path of waves that reach **R** directly and the path of waves that reach **R** by reflection from **M**.

0 2 . 2 Explain what happens to the signal detected by **R** as **M** is moved slowly towards **X**.

[4 marks]

Figure 3 shows an arrangement used in a different experiment to try to determine the wavelength of the microwaves.

Figure 3



A double-slit arrangement is placed between **T** and **R**.

The initial position of **R** is the same distance from each slit and is 0.45 m from the midpoint of the two slits.
AB is a line perpendicular to the line between **T** and the initial position of **R**.
R can be moved 0.25 m towards **A** and 0.25 m towards **B** along **AB**.

The two slits act as two coherent sources with a separation of 0.12 m.

0 2 . 3 Suggest why Young's double-slit equation should **not** be used to determine the wavelength.

[1 mark]

0 2 . 4 The wavelength is known to be about 3 cm.

Deduce whether this practical arrangement is suitable for a determination of a value for the wavelength.

[3 marks]

2. No. 03

0 3 **Figure 4** shows a ray of monochromatic light incident at angle A from air onto the end of a straight optical fibre.

This ray undergoes total internal reflection at the core–cladding boundary. A ray that enters the optical fibre at an angle greater than A will only be partially reflected at the core–cladding boundary.

Figure 4

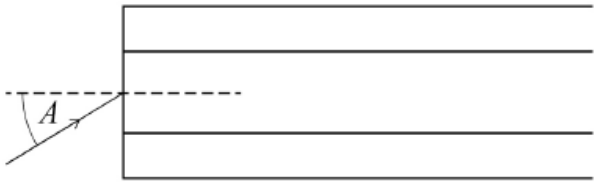


Table 2 shows some properties of the optical fibre.

Table 2

	Refractive index
cladding	1.41
core	1.47

0 3 . 1 Calculate the speed of the light ray in the optical fibre.

[1 mark]

speed = _____ $\mathrm{m\ s^{-1}}$

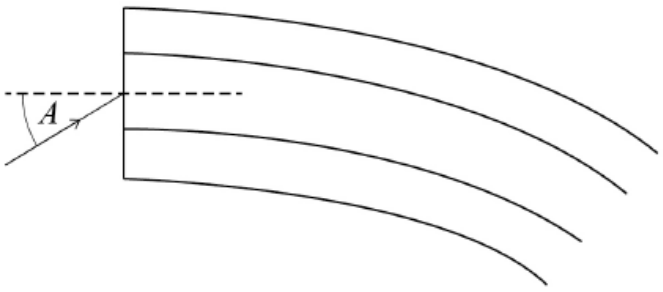
0 3 . 2 Calculate A, in degrees, for the optical fibre shown in **Figure 4**.

[3 marks]

$A =$ _____ degrees

0 3 . 3 A ray is incident on the optical fibre at angle A. The optical fibre is now bent, as shown in **Figure 5**.

Figure 5

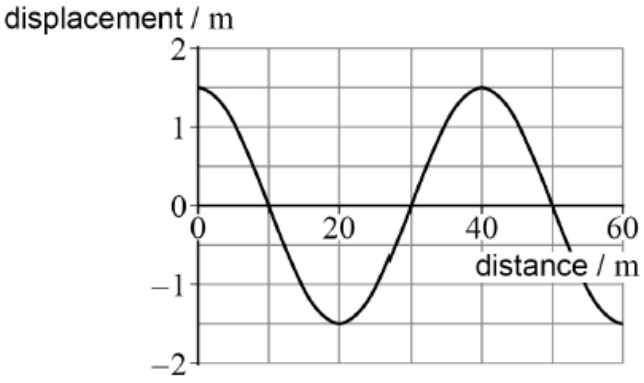


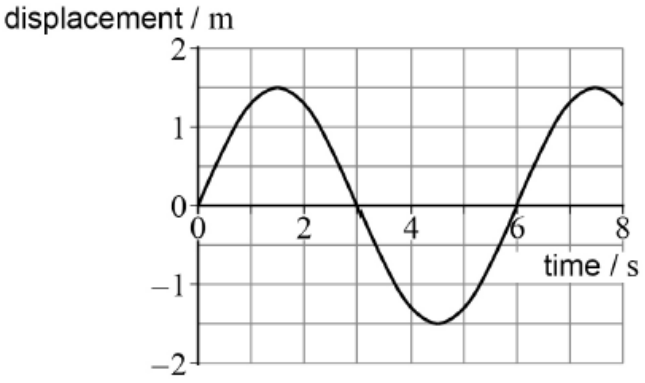
Draw, on **Figure 5**, what happens to the ray within the optical fibre.
Explain your answer.

[3 marks]

3. No. 17

The diagrams show the displacement–distance graph for a wave and the displacement–time graph for a point in the wave.





Which is correct for this wave?

[1 mark]

A The amplitude is 3.0 m. ⬭

B The wavelength is 6 m. ⬭

C The speed is 8.3 m s^{-1}. ⬭

D The frequency is 0.17 Hz. ⬭

4. No. 18

The diagram shows a stationary wave on a string at one instant in time.
P, **Q** and **R** are three points on the string.

Which row is correct?

[1 mark]

A	**P** is in antiphase with **R**	**P** has the same amplitude as **Q**	⬭
B	**P** is out of phase with **R**	**P** has the same amplitude as **R**	⬭
C	**P** is in phase with **Q**	**P** has the same amplitude as **R**	⬭
D	**P** is out of phase with **Q**	**P** has a smaller amplitude than **R**	⬭

5. No. 19

A diffraction grating is illuminated normally.

The second-order maximum for light of wavelength 650 nm occurs at the same angle as the third-order maximum for light of wavelength λ.

What is λ?

[1 mark]

A 217 nm ⬭

B 325 nm ⬭

C 433 nm ⬭

D 975 nm ⬭