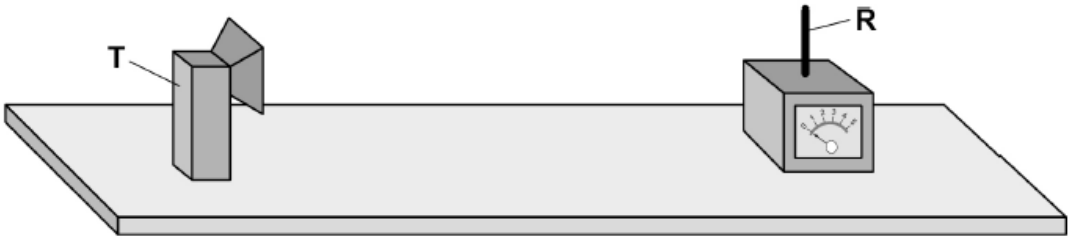
AQA – Waves – A2 Physics P1

1. June/2021/Paper_7408_01/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

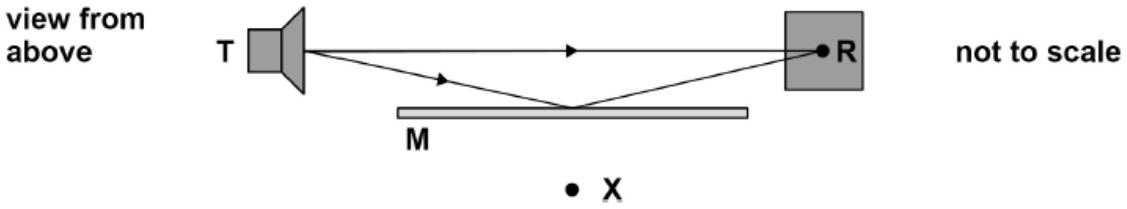
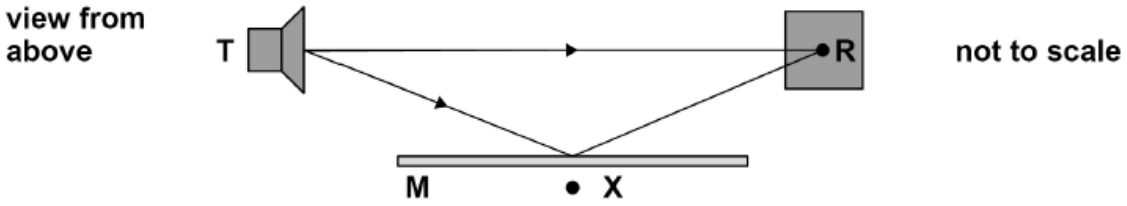


Figure 2b



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.

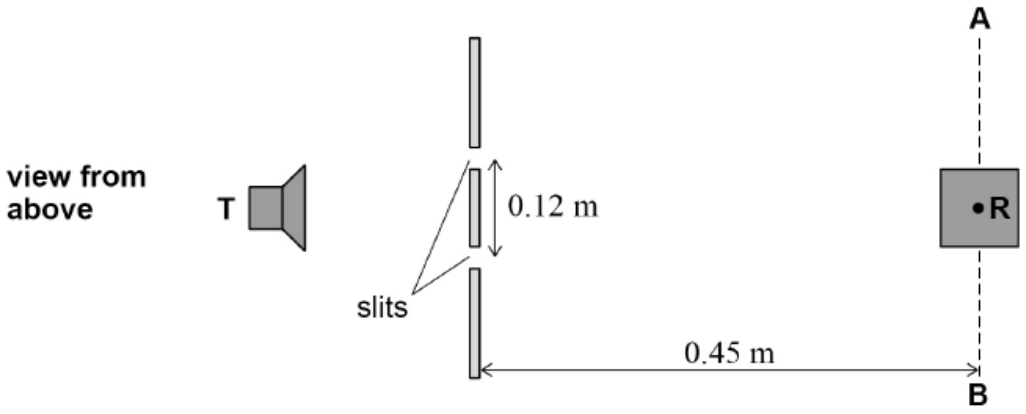
The arrowed lines show the path of waves that reach **R** directly and the path of waves that reach **R** by reflection from **M**.

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. June/2021/Paper_7408_01/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

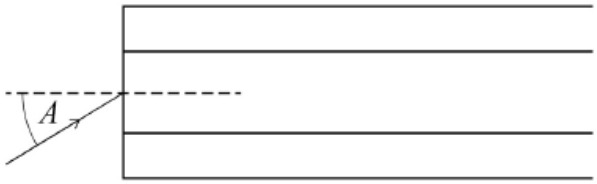


Table 2 shows some properties of the optical fibre.

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

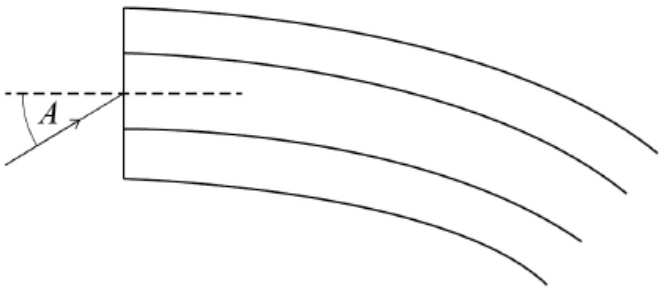
0 3 . 2 Calculate A, in degrees, for the optical fibre shown in **Figure 4**.

[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

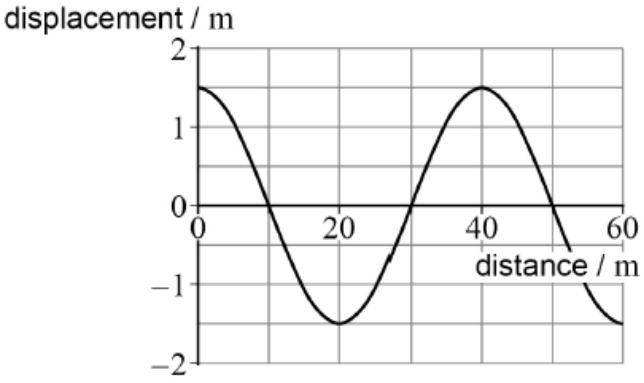


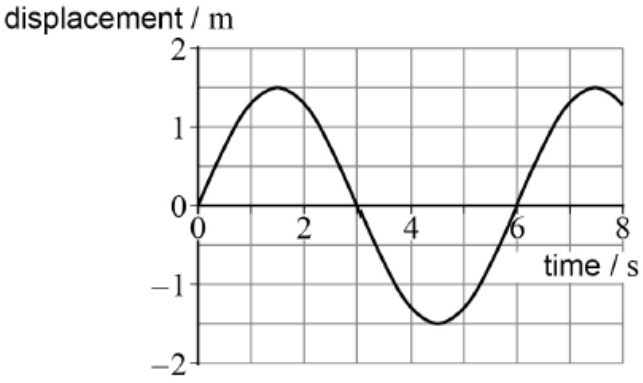
Draw, on **Figure 5**, what happens to the ray within the optical fibre.
Explain your answer.

[3 marks]

3. June/2021/Paper_7408_01/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. June/2021/Paper_7408_01/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. June/2021/Paper_7408_01/No. 19

A diffraction grating is illuminated normally.

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

What is λ?

[1 mark]

A $217\ \text{nm}$ ⬭

B $325\ \text{nm}$ ⬭

C $433\ \text{nm}$ ⬭

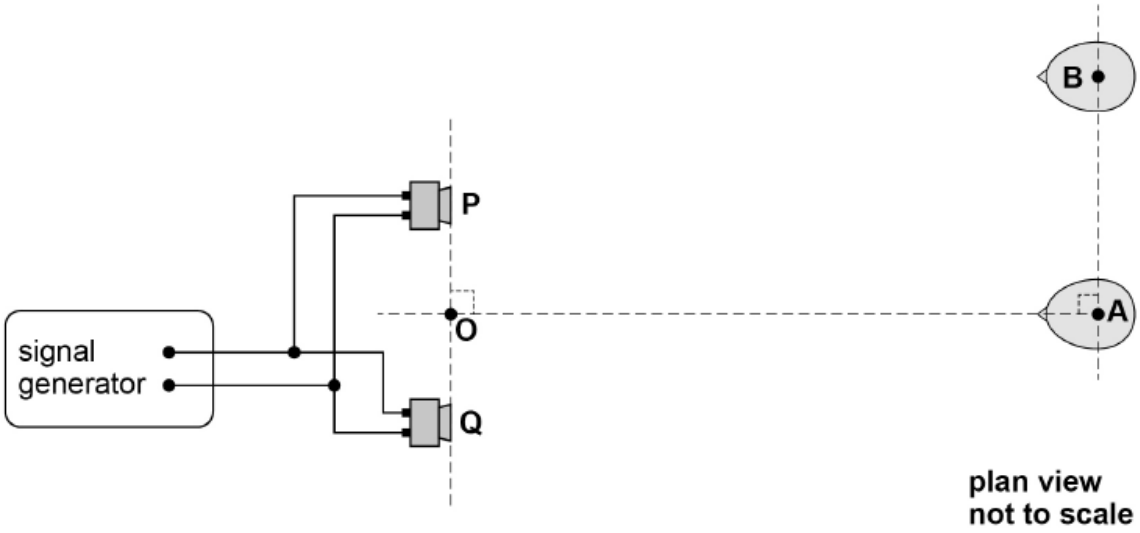
D $975\ \text{nm}$ ⬭

6. June/2020/Paper_7408_01/No. 03

0 3 A student investigates the interference of sound waves using two loudspeakers, **P** and **Q**, connected to a signal generator (oscillator). Each loudspeaker acts as a point source of sound.

Figure 3 shows the arrangement.

Figure 3



Point **O** is the midpoint between **P** and **Q**.

0 3 . 1 Explain why the two loudspeakers are coherent sources of sound waves.

[2 marks]

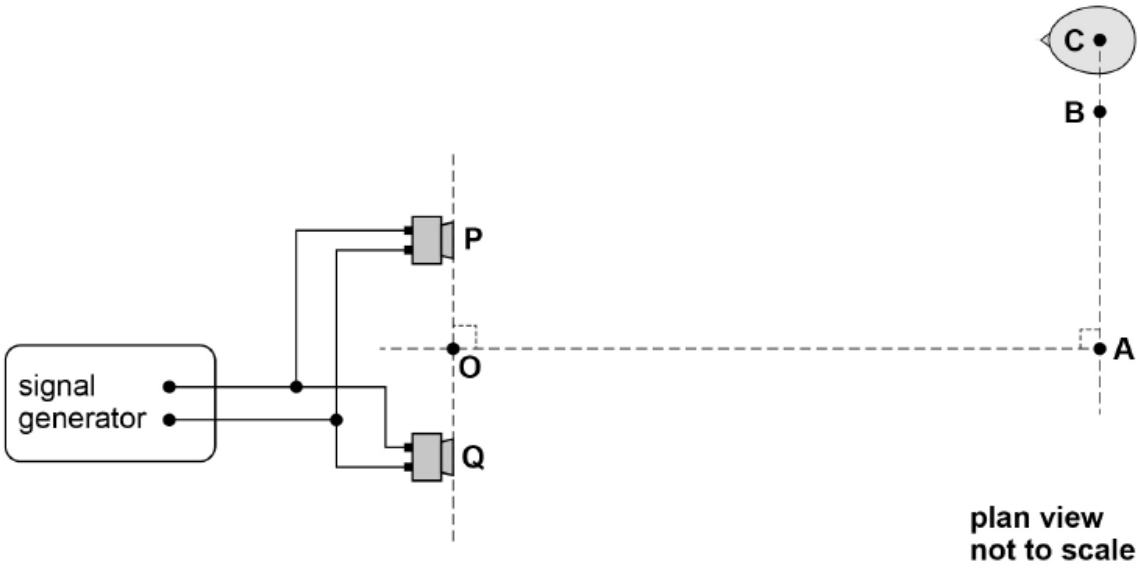
0 3 . 2 The student faces the two loudspeakers at point **A**. Point **A** is at equal distances from **P** and **Q**.
He then moves to point **B**, at right angles to the line **OA**, still facing the two loudspeakers.
As his head moves from **A** to **B** the amplitude of the sound wave he hears decreases and then increases. The amplitude starts to decrease again as he moves beyond **B**.

Explain why the variation in amplitude occurs as he moves from **A** to **B**.

[3 marks]

0 3 . 5 The student moves his head to point **C** as shown in **Figure 4**. The emitted frequency of the sound from the loudspeakers is then gradually decreased.

Figure 4



Discuss the effect that this decrease in frequency has on the amplitude of the sound wave heard by the student.

[3 marks]

7. June/2020/Paper_7408_01/No. 14

A monochromatic light wave travels from glass into air.

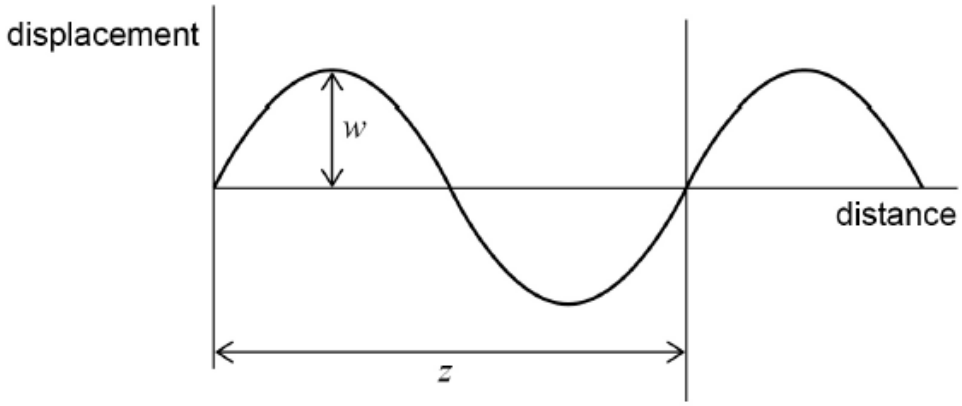
Which row shows what happens to the wavelength, speed and photon energy?

[1 mark]

	Wavelength	Speed	Photon energy	
A	increases	increases	increases	⬭
B	does not change	decreases	does not change	⬭
C	does not change	decreases	increases	⬭
D	increases	increases	does not change	⬭

8. June/2020/Paper_7408_01/No. 15

A wave travels across the surface of water.
The diagram shows how the displacement of water particles at the surface varies with distance.



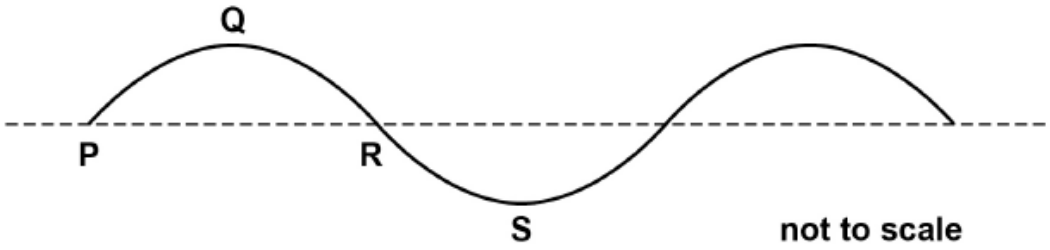
Which row correctly describes both w and z?

[1 mark]

	w	z	
A	amplitude	wavelength	⬭
B	half-amplitude	period	⬭
C	half-amplitude	wavelength	⬭
D	amplitude	period	⬭

9. June/2020/Paper_7408_01/No. 16

The diagram shows the cross-section of a progressive transverse wave travelling at 24 cm s^{-1} on water. The amplitude of the wave is 2.0 cm and the frequency is 4.0 Hz.



Which statement is correct?

[1 mark]

A The phase difference between particles at **P** and **S** is $\frac{\pi}{2}$ rad. ⬭

B The distance between **P** and **R** is 6.0 cm. ⬭

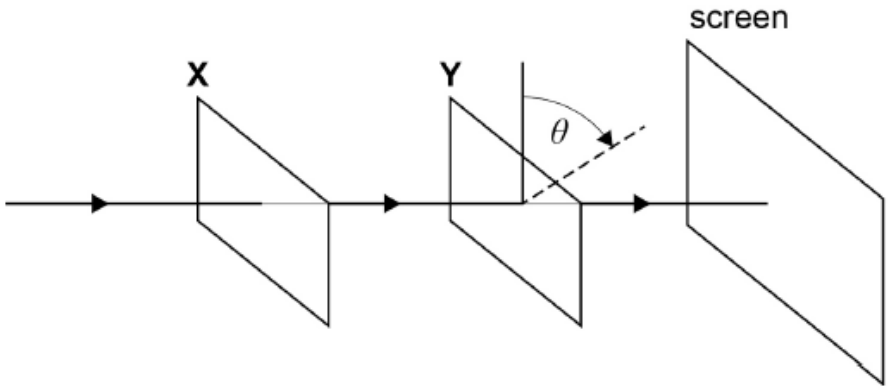
C The particle velocity at **Q** is a maximum. ⬭

D Particles at **P** and **R** are in phase. ⬭

10. June/2020/Paper_7408_01/No. 17

Unpolarised light travels through two polarising filters **X** and **Y** and is then incident on a screen. When **X** and **Y** are arranged as shown, there is a maximum intensity on the screen.

X is held stationary but **Y** is rotated in a plane at right angles to the beam so that θ increases.



What are the next three values of θ, in rad, for which the beam hits the screen with maximum intensity?

[1 mark]

A $\frac{\pi}{2}, \frac{2\pi}{2}, \frac{3\pi}{2}$ ⬭

B $\frac{\pi}{2}, \frac{3\pi}{2}, \frac{5\pi}{2}$ ⬭

C $\pi, 2\pi, 3\pi$ ⬭

D $2\pi, 4\pi, 6\pi$ ⬭

11. June/2020/Paper_7408_01/No. 18

Stationary waves are set up on a rope of length $1.0\ \text{m}$ fixed at both ends.

Which statement is **not** correct?

[1 mark]

A The first harmonic has a wavelength of $2.0\ \text{m}$. ⬭

B The midpoint of the rope is always stationary for even-numbered harmonics. ⬭

C A harmonic of wavelength $0.4\ \text{m}$ can be set up on the rope. ⬭

D There are five nodes on the rope for the fifth harmonic. ⬭

12. June/2020/Paper_7408_01/No. 19

Monochromatic light is incident normally on a diffraction grating that has 4.50×10^5 lines m^{-1}.
The angle between the second-order diffraction maxima is $44°$.

What is the wavelength of the light?

[1 mark]

A $208\ \text{nm}$ ⬭

B $416\ \text{nm}$ ⬭

C $772\ \text{nm}$ ⬭

D $832\ \text{nm}$ ⬭