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Section B

Each of Questions **07** to **31** is followed by four responses, **A**, **B**, **C** and **D**.

For each question select the best response.

Only **one** answer per question is allowed.
For each question, completely fill in the circle alongside the appropriate answer.

CORRECT METHOD 

WRONG METHODS 

If you want to change your answer you must cross out your original answer as shown. 

If you wish to return to an answer previously crossed out, ring the answer you now wish to select as shown. 

You may do your working in the blank space around each question but this will not be marked. Do **not** use additional sheets for this working.

0 7 Which is approximately equal to $3\ \text{kW h}$?

[1 mark]

A $3 \times 10^3\ \text{J}$ ⬭

B $1 \times 10^4\ \text{J}$ ⬭

C $2 \times 10^5\ \text{J}$ ⬭

D $1 \times 10^7\ \text{J}$ ⬭

0 8 Which is the shortest distance?

[1 mark]

A $10^{-19}\ \text{Gm}$ ⬭

B $10^{-14}\ \text{km}$ ⬭

C $10^{-4}\ \mu\text{m}$ ⬭

D $10^7\ \text{fm}$ ⬭

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0 9 The gravitational force is one of the four fundamental forces.
The ticks in the table match particles with the other fundamental forces.

In which row is the particle matched to the only other fundamental forces it experiences?

[1 mark]

	Particle	Electromagnetic force	Weak nuclear force	Strong nuclear force	
A	μ^+	✓	✓		⬭
B	$\overline{p}$	✓		✓	⬭
C	π^0	✓	✓	✓	⬭
D	ν_e		✓	✓	⬭

1 0 The proton number of uranium is 92 and the proton number of radon is 88

Which series of decays turns a uranium nucleus into a radon nucleus?

[1 mark]

A $\alpha + \beta^- + \beta^- + \alpha + \alpha$ ⬭

B $\beta^- + \beta^- + \alpha + \beta^- + \alpha$ ⬭

C $\alpha + \alpha + \alpha + \alpha + \beta^-$ ⬭

D $\beta^- + \beta^- + \beta^- + \beta^- + \alpha$ ⬭

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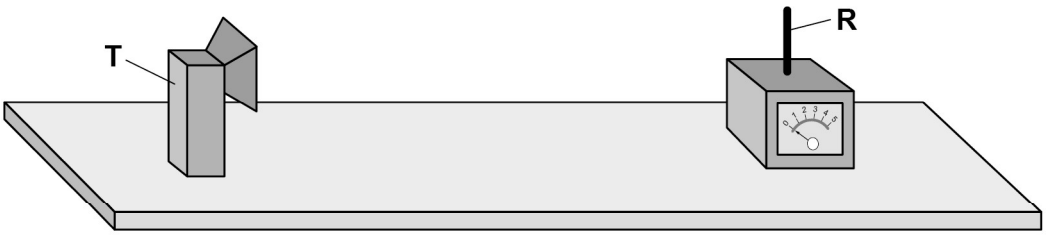
0 2 **Figure 1** shows apparatus used to investigate the properties of microwaves.
The microwaves from the transmitter **T** are vertically polarised and have a wavelength of about 3 cm.
The microwaves are detected at the receiver by a vertical metal rod **R**.

Figure 1



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

[3 marks]

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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

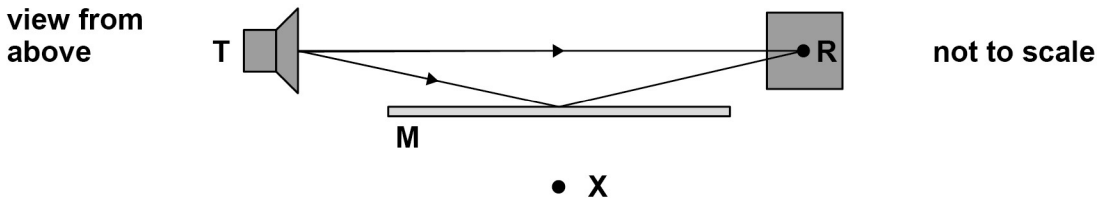
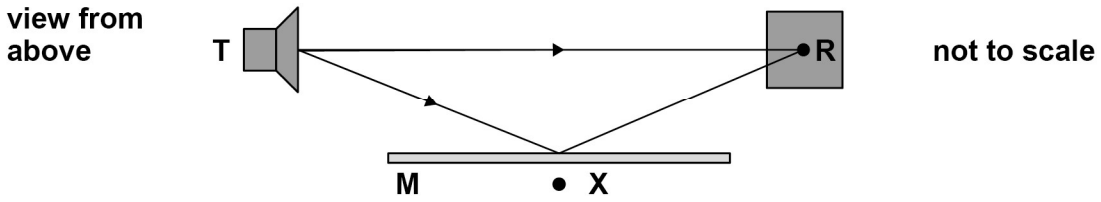


Figure 2b



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]

Question 2 continues on the next page

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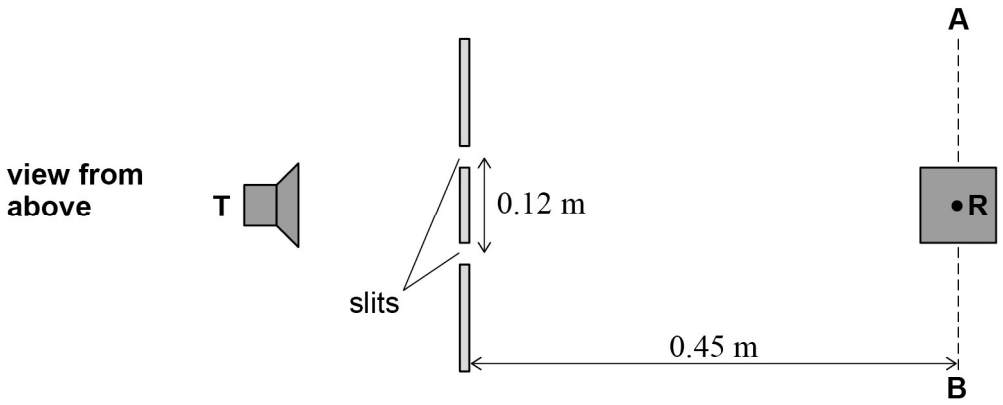
Figure 3 shows an arrangement used in a different experiment to try to determine the wavelength of the microwaves.

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 $0.45\ \text{m}$ 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 $0.25\ \text{m}$ towards **A** and $0.25\ \text{m}$ towards **B** along **AB**.

The two slits act as two coherent sources with a separation of $0.12\ \text{m}$.

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

[1 mark]

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0 2 . 4 The wavelength is known to be about $3\ \text{cm}$.

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

[3 marks]

11

Turn over for the next question

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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

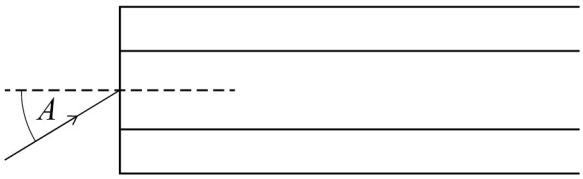

Table 2 shows some properties of the optical fibre.

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 = _____ m s^{-1}

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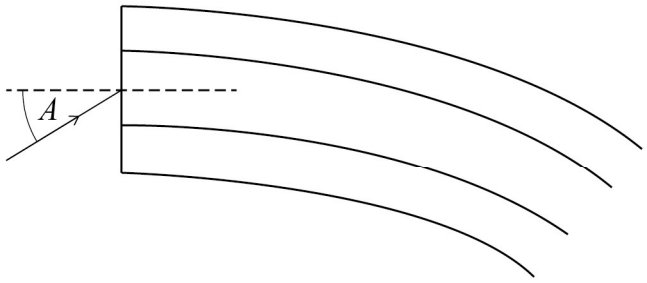
0 3 . 2 Calculate A, in degrees, for the optical fibre shown in **Figure 4**.

[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]

7