



12 Pages

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3. The answers must be legibly written. The Examiners can either read the script or have it typed and the expense of typing charged to the candidate.
4. Write your answers in ink.
5. Begin each answer on a fresh page. Do all rough work in the answer book and cross it through.
6. No part of this book is to be torn out; it must be handed in complete.
7. If more books than one are used, fasten them together using the tags available from the invigilator(s).
8. **Every book must be handed in. In no circumstances may answer books, used or unused, be taken out of the examination venue.**

1	Student Number	2308626
2	Title of Examination Paper	Electromagnetic Radiation
3	Module Code	ACDC 5009
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5	Examination Venue	UWFSD swansea 310
6	Seat Number	59
7	Number of Answer Books handed in	1

[illegible]

(Gweler yr ochr arall am y fersiwn Cymraeg)

$\frac{40}{100}$

1 a

?

0

$$b \quad E = \frac{a_1}{4\pi\epsilon_0 r_{ip}^2} \bar{\sigma}_{ip}$$

?

2

$$d = \sqrt{(0.2 - -0.2)^2 + (0.1)^2 + (-2.5 - -2.5)^2}$$

$$d = 0.458$$

$$d^2 = \frac{21}{100}$$

$$\bar{\sigma}_{ip} = \frac{0.4x + 0.1y - 0.2z}{0.458}$$

$$0.873x + 0.218y - 0.437z$$

$$\frac{5 \times 10^{-12}}{4\pi \times 8.854 \times 10^{-12} \times \frac{21}{100}} \times 0.873x + 0.218y - 0.437z$$

$$\begin{array}{rcl} 0.2184 & \times 0.873 & = 0.1887x \\ & \times 0.218 & = 0.0474y \\ & \times -0.437 & = -0.0951z \end{array}$$

?

2

c

0

Q. = 10 ✓

2a

they can propagate ~~without~~ a ~~medium~~
medium

they travel at the speed of sound ✓
the frequency is determined by the amount
of waves a ~~second~~ ✓

2 ✓

d
1

✓

0

11

✓

C

$$F = \frac{N \lambda / 2}{2 \pi d}$$

$$F/L = \frac{N \lambda / 2}{2 \pi d}$$

$$F/L = \frac{4 \pi \times 10^{-7} \times 3 \times 6}{2 \pi \times 5 \times 10^{-2}}$$

$$F/L = \frac{0.000226}{2 \pi \times 5 \times 10^{-2}}$$

$$0.000 \frac{2.26 \times 10^{-5}}{\pi \times 10^{-1}}$$

$$F/L = 7.19 \times 10^{-5}$$

d

$$NA = 0.48$$

$$n = 1.45$$

NA

$$0.48 = \sqrt{1.45^2 - n^2}$$

$$0.48^2 = 1.45^2 - n^2$$

$$n^2 = \sqrt{1.45^2 - 0.48^2}$$

$$n = 1.38$$

$$\phi = \sin^{-1} \left(\frac{NA}{n} \right)$$

$$\sin^{-1} \left(\frac{0.48}{1} \right)$$

$$\phi = 28.68$$

Q2 = (14)

3

a

$$1 \quad f_c = \frac{c}{2} \sqrt{\left(\frac{m}{a}\right)^2 + \left(\frac{n}{b}\right)^2}$$

$$11 \quad \lambda_c = \frac{c}{f_c}$$

b

c

d

$$f = \frac{c}{\lambda} \quad f = \frac{3 \times 10^8}{8 \times 10^{-4}}$$

$$f = 3.75 \times 10^{11}$$

Q3 = 5

4

a

$$I = 2 \text{ G}$$

$$V = 1000 \text{ V}$$

0

b

$$2 \times 10^{-6} \text{ s Delay}$$

$$2 \times 10^{-6} \div 2 = 1 \times 10^{-6}$$

$$(1 \times 10^{-6}) \cdot (3 \times 10^8) = 300 \text{ m}$$

2 ✓

3 ✓

c

$$f = 5 \text{ GHz } 5 \times 10^9$$

$$P = 150 \times 10$$

$$I = \frac{3 \times 10^8}{5 \times 10^9} = 0.06$$

1 ✓

$$II \quad \frac{(150 \times 10^3) \times 25 \times 20 \times (1000)^2 \times 8}{(4\pi)^3 (2 \times 10^4)^4 \times 1.5}$$

$$Pr = \frac{P + G + G_r \times \sigma}{(4\pi)^3 R^4 L}$$

2 ✓

$$\frac{2.16 \times 10^6}{4.76 \times 10^{20}} = 4.538 \times 10^{-15}$$

3

(11)



Question No.

Examiner Only

d

7

0

