



Complete, fold and seal
(see note 2 below)

SURNAME: SAVIN

FORENAME(S): LUKE JAMES

Examination Answer Books

12 Pages

Instructions to Candidates

1. Please give the information requested in the boxes below.
2. Enter your name in the space provided to the right, fold over and seal down (using the label provided) to hide your name.
3. The answers must be legibly written. The Examiners can either ignore illegible 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	1810328
2	Title of Examination Paper	Electromagnetic Radiation
3	Module Code	ALDA5009
4	Date and Time of Examination	10:00 3/5/2022
5	Examination Venue	IG 002
6	Seat Number	
7	Number of Answer Books handed in	1

List the numbers of the questions you have attempted	Office Use
1	17
2	10
3	7 10
4	16
5	22
6	10
Total	

1a+b Radio waves - Induces a current in a conductor

Microwaves - Induces a current in conductors and produces heat in non conductors

Infrared - Produces heat in conductors and non conductors. Does ~~not~~ induce current

Visible light - Can be seen

Ultraviolet - Can't be seen. Biologically harmful

X-ray - Ionising due to electrons

Gamma - Ionising due to Nuclear

c) Refraction - The ~~change~~ redirection of a wave through a medium

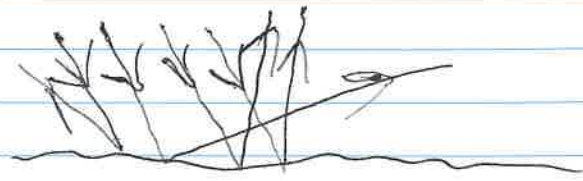
d) Diffraction - The change of direction around a corner or object

e) Dispersion - The separation of a wave through a medium

f) Specular reflection - Waves hitting a smooth surface and reflecting at the same or opposite angle



g) Diffuse reflection - Wave hitting a rough surface and going reflecting at different angles



i) (Absorption) The energy used by a wave to travel through a medium



4

h)



Q1 = 17

$$2a) \frac{3 \times 10^3}{433 \times 10^6} = 0.628 = 0.173m$$

2

b) Line of sight
Ground plane (earthing)
Orientation

3

$$c) I_1 D_2^2 = I_2 D_1^2$$

$$\frac{10 \times 270^2}{90^2} = 90 \text{ mW}$$

2

d) The antenna can be redesigned to be directional

1

$$e) 6 \times 8 = \frac{48}{40000} = 1.2 \times 10^{-3} \text{ ms}$$

2

3a) A black body radiator is a material that can absorb all EMR at all frequencies and all angles



Q2 = 10

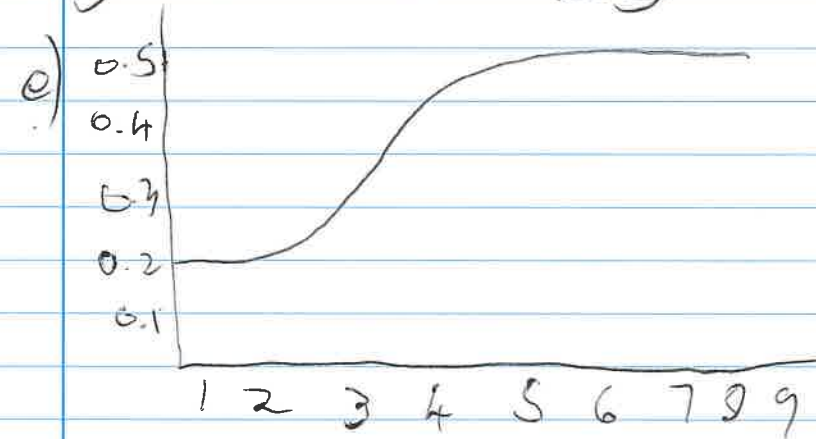
2

d) Silver - 0.02
Black paint - 0.98



3

Emissivity is the ratio of radiation emitted by a black body against the radiation absorbed by a black body



1

f) Dark olive green absorbs all frequency where as white paint reflects radiation at a higher frequency than it absorbs

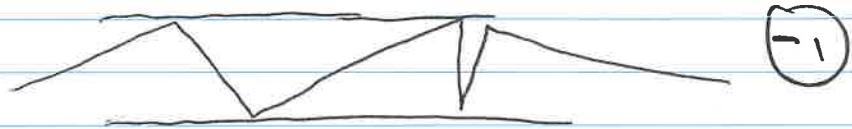


1

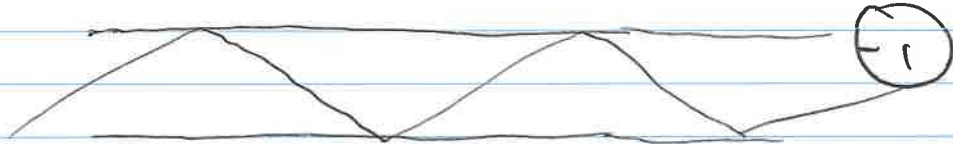
* B and C appear ↓ out of paper
+3 marks.

- 4) Higher bandwidth
 Cheaper
~~Reliable~~ More reliable
 Less weight
 2 way communication
 More secure
 Less susceptible to interference
 Thinner

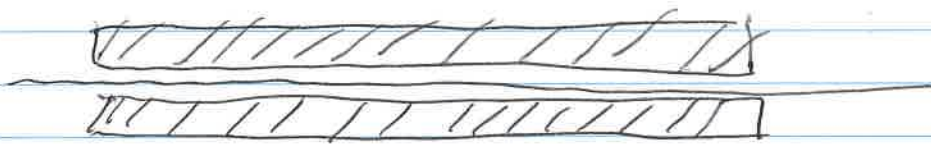
4b) Step index - Cheap - Robust - Short distance - 1 mb^s



Graded index - Bit more expensive - less robust - 10 km - 10 mb^s



Mono mode - Expensive - High performance - Not robust - 100 km - 1 Gb^s



- c) Graded index, as step index doesn't travel far enough and Mono mode is too expensive and not robust enough.

(-3)

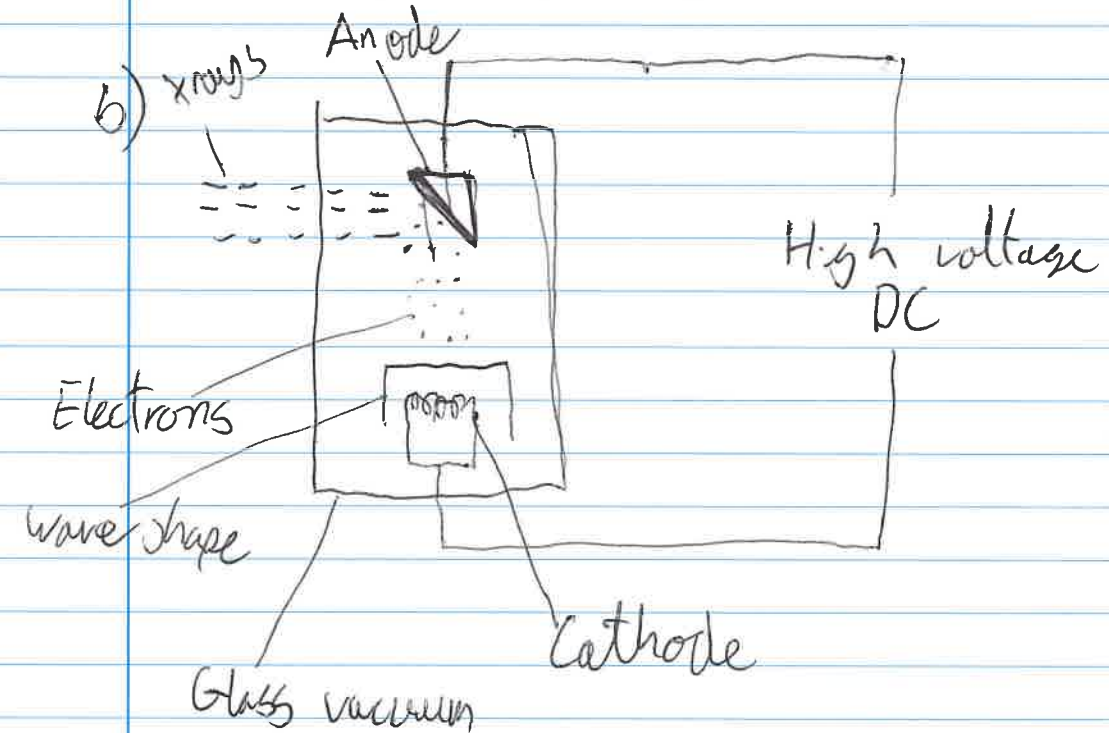
Q4 = 16

5) Crystallography - looking at the size of crystals in explosive

Quality control - looking at voids in casing

Security - Airport security

Flash xray - High speed pers. on imaging



- c) When electrons collide with the target it knocks the electron out of its inner shell. An electron from the outer shell replaces the inner electron. In doing such releases a xray photon.

- 1 d) When an ~~electron~~ photon ~~hits~~ hits a charged particle eg electron, the photons energy is decreased.

(-1)

- 5 e) Density
Thickness
X-ray energy
Atomic mass
Atomic number

4 f) $\mu \sim \frac{\rho Z^4}{AE^3}$

μ = Absorption Coefficient
 E = X-ray energy
 A = Atomic mass
 ρ = Density
 Z = Atomic number

g) (-3)

Q5 = 22

- 6a) Directly proportional to length of conductor 2
proportional to the size of conductor 2
Directly proportional to the angle
Inversely proportional to the

(-6)

6) 1N The definition of a Tesla

5

d) ~~$L = \frac{\mu N^2 A}{l}$~~

$L = \frac{\mu N^2 A}{l}$

$N = \sqrt{\frac{(L)(l)}{(\mu)(A)}}$

$L = 40 \mu H$
 $\mu = 4\pi \times 10^{-7}$
 $l = 10$
 $A = (\pi r^2) = (\pi (0.1)^2)$

$N = \sqrt{\frac{(40 \times 10^{-6})(10)}{(0.01)(\pi (0.01)^2)}}$

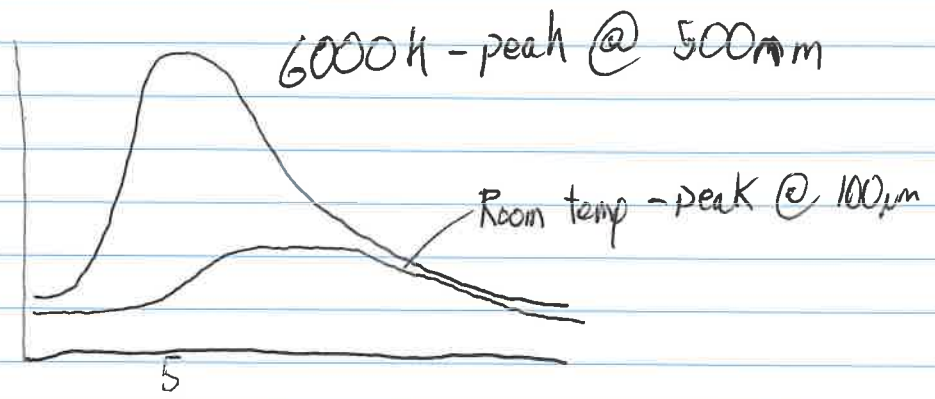
(-4)

Q6 = 10

Question 3c + 3b on next page

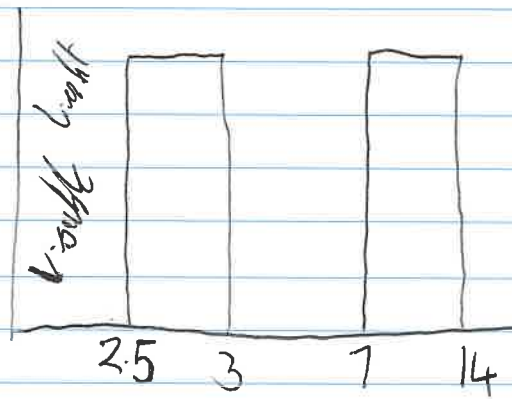
24

31)



3

32)



~~Gases in the atmosphere
absorb different wave
at diff. lgs.~~